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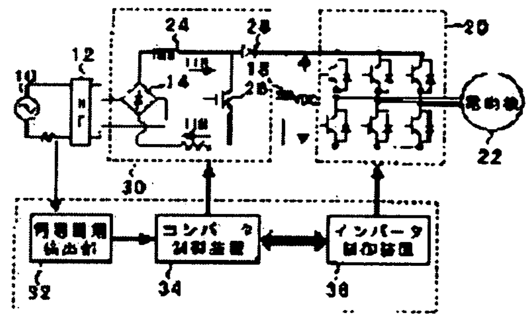
(54) DRIVE CONTROLLER FOR MOTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To positively inhibit the effect of a power-supply ripple with respect to a motor by constitution at a low cost.

SOLUTION: A converter 30 which converts an AC voltage into a DC voltage VDC and an inverter 20 supplying the motor 22 with a drive signal in amplitude in the width of DC voltage VDC are installed. A converter controller 34 which repeatedly executes voltage control for making a DC voltage match with a VDC output from the converter 30 at a specified voltage command value. An inverter controller 36, which repeatedly executes voltage control for controlling the drive signal output from the inverter 20 on the basis of DC voltage VDC, is installed. Voltage control by the converter controller 34 and voltage control by the inverter controller 36 are executed synchronously.



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CLAIMS

[Claim(s)]
[Claim 1] It is the drive control unit of a motor equipped with the converter which changes alternating voltage into direct current voltage, and the inverter which supplies to a motor the driving signal which carries out the amplitude by the width of face of said direct current voltage. The converter control unit which repeats and performs armature-voltage control for making in agreement with an electrical-potential-difference command value said direct current voltage outputted from said converter, While having the inverter control unit which repeats and performs armature-voltage control for controlling the driving signal outputted from said inverter on the basis of said direct current voltage The drive control device of the motor characterized by being carried out by the armature-voltage control by said converter control device and the armature-voltage control by said inverter control device synchronizing.
[Claim 2] The armature-voltage control by said inverter control device is the drive control device of the motor according to claim 1 characterized by being started when the predetermined time taken for said direct current voltage to turn into an average electrical potential difference passes, after the armature-voltage control by said converter control device was started.
[Claim 3] Said converter control unit is a drive control unit of the motor according to claim 1 or 2 characterized by performing said armature-voltage control repeatedly synchronizing with the fluctuation period of supply voltage.
[Claim 4] The drive control unit of the motor characterized by having the converter control unit which is a drive control unit of a motor equipped with the converter which changes alternating voltage into direct current voltage, and the inverter which supplies to a motor the driving signal which carries out the amplitude by the width of face of said direct current voltage, and performs armature-voltage control for making said direct current voltage in agreement with an electrical-potential-difference command value repeatedly synchronizing with the fluctuation period of supply voltage.
[Claim 5] The electrical-potential-difference command value supplied to said converter control device while the armature-voltage control which said inverter control device performs is duty control which makes the driving signal supplied to a motor a predetermined duty ratio is claim 1 characterized by being set up so that the duty ratio of said driving signal may become less than 100% thru/or the drive control device of the motor of four given in any 1 term.
[Claim 6] The armature-voltage control which said inverter control unit performs The electrical-potential-difference command value which is the duty control which makes the driving signal supplied to a motor a predetermined duty ratio, and is supplied to said converter control unit They are claim 1 characterized by being the value which subtracted required tolerance from 100% when amending the ripple which is set up so that the duty ratio of said driving signal may serve as a predetermined value, and superimposes said predetermined value on said direct current voltage thru/or the drive control unit of the motor of four given in any 1 term.
[Claim 7] While having the ripple amendment section which calculates the ripple correction value for offsetting the electrical-potential-difference ripple which originates in a powerline period and is superimposed on said direct current voltage based on the load of a motor, said inverter control unit is claim 1 characterized by performing amendment for preventing that the effect of the electrical-potential-difference ripple resulting from a powerline period attains to a motor thru/or a drive control unit of the motor of six given in any 1 term based on said ripple correction value.
[Claim 8] Said ripple amendment section is the drive control unit of the motor according to claim 7 characterized by detecting the load of a motor based on the engine speed of a motor, and the output voltage of said inverter.
[Claim 9] Said ripple amendment section is the drive control unit of the motor according to claim 7 characterized by detecting the load of a motor based on the input current which flows into a converter from

AC power supply.
[Claim 10] Said ripple amendment section is the drive control unit of the motor according to claim 7 characterized by detecting the load of a motor based on said direct current voltage outputted from a converter, and the rotational frequency of a motor.
[Claim 11] Claim 1 characterized by having the control gain controller which changes the control gain of the armature-voltage control by said converter control unit so that the output command value may be stabilized when changing the output command value of said inverter control unit in predetermined time thru/or the drive control unit of the motor of ten given in any 1 term.
[Claim 12] Claim 1 characterized by having the control output-value amendment section which amends to the output command value of said converter control unit so that the output command value may be stabilized when changing the output command value of said inverter control unit in predetermined time thru/or the drive control unit of the motor of ten given in any 1 term.
[Claim 13] Said motor is claim 1 characterized by being the driving source of a compressor thru/or the drive control unit of the motor of 12 given in any 1 term.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the drive control device of a motor, and relates to the drive control device of the motor which has the converter control device which changes alternating voltage into predetermined direct current voltage especially, and the inverter control device which controls the engine speed of a motor to a desired engine speed.
[0002]
[Description of the Prior Art] Drawing 24 shows the circuit diagram of the drive control unit of the motor indicated by JP,8-19259,A. drawing 24 -- setting -- 10 -- for a diode bridge and 16, as for a smoothing capacitor and 20, an active filter and 18 are [AC power supply and 12 / a noise filter and 14 / an inverter and 22] motors. The active filter 16 is equipped with a reactor 24, a switching element 26, and diode 28.
[0003] An inverter 20 is an inverter of a well-known three phase circuit, and controls the motor 22 connected as a load to a desired rotational frequency. An active filter 16 is a well-known pressure-up mold converter, and controls mostly the input current which outputs desired direct current voltage to the both ends of a smoothing capacitor 18, and flows into an active filter from AC power supply 10 in the shape of a sine wave by controlling a switching element 26.
[0004] The above-mentioned conventional drive control device changes the switching frequency of a switching element 26 suitably so that both the switching loss accompanying switching of a switching element 26 and the ripple current which flows to a reactor 24 may decrease. Switching loss and a ripple current have an opposite relation. The conventional drive control device tends to control the both sides of switching loss and a ripple current suitably by changing a switching frequency according to a burden.
[0005]
[Problem(s) to be Solved by the Invention] The active filter 16 shown in drawing 22 is a pressure-up mold converter generally known, and tends to reduce a ripple current by changing a switching frequency. However, it is difficult to remove effectively the electrical-potential-difference ripple which originates in a powerline period in the circuitry which uses only one switching element 26 when especially the capacity of a smoothing capacitor 18 is little, i.e., the electrical-potential-difference ripple resulting from periodic change of supply voltage. Moreover, if control for making direct current voltage into a predetermined electrical potential difference by the pressure-up converter is performed when a ripple is overlapped on direct current voltage (both-ends electrical potential difference of a smoothing capacitor 18), the electrical-potential-difference ripple resulting from the control will newly occur in direct current voltage.
[0006] In the conventional drive control device, when the ripple is overlapped on direct current voltage, the direct current voltage which had a ripple also in the inverter 20 connected to the smoothing capacitor 18 is inputted. In this case, unless an electrical-potential-difference ripple is compensated by the inverter 20, in a motor 22, the rotation nonuniformity resulting from an electrical-potential-difference ripple arises. Such rotation nonuniformity causes noise of a motor 22. For this reason, the cure which compensates an electrical-potential-difference ripple with an inverter 20, or the cure of giving sufficient capacity for a smoothing capacitor 18, and controlling generating of an electrical-potential-difference ripple is usually taken so that the ripple of direct current voltage may not affect a motor 22.
[0007] By the way, the ripple resulting from a powerline period and the ripple resulting from control of a converter (active filter 16) are overlapped on the direct current voltage supplied to an inverter 20 like ****. Therefore, in order to eliminate the effect of an electrical-potential-difference ripple with a sufficient precision, in an inverter 20, it is required to perform control which compensates these two electrical-potential-difference ripples. However, in order to fill the above-mentioned demand, it is required to perform complicated control in an inverter 20. For this reason, it was actually difficult to eliminate completely the

effect of the electrical-potential-difference ripple to a motor 22 depending on the conventional drive control unit.
[0008] This invention was made in order to solve the above technical problems, and it sets it as the 1st purpose to offer the drive control unit of the motor which can control certainly the effect of the power-source ripple to a motor with a cheap configuration.
[0009]
[Means for Solving the Problem] The converter from which invention according to claim 1 changes alternating voltage into direct current voltage, It is the drive control unit of a motor equipped with the inverter which supplies to a motor the driving signal which carries out the amplitude by the width of face of said direct current voltage. The converter control unit which repeats and performs armature-voltage control for making in agreement with an electrical-potential-difference command value said direct current voltage outputted from said converter, While having the inverter control unit which repeats and performs armature-voltage control for controlling the driving signal outputted from said inverter on the basis of said direct current voltage It is characterized by being carried out by the armature-voltage control by said converter control device and the armature-voltage control by said inverter control device synchronizing.
[0010] Invention according to claim 2 is the drive control device of a motor according to claim 1, and is characterized by starting the armature-voltage control by said inverter control device, when the predetermined time taken for said direct current voltage to turn into an average electrical potential difference passes, after the armature-voltage control by said converter control device was started.
[0011] Invention according to claim 3 is the drive control device of a motor according to claim 1 or 2, and said converter control device is characterized by performing said armature-voltage control repeatedly synchronizing with the fluctuation period of supply voltage.
[0012] Invention according to claim 4 is the drive control unit of a motor equipped with the converter which changes alternating voltage into direct current voltage, and the inverter which supplies to a motor the driving signal which carries out the amplitude by the width of face of said direct current voltage, and is characterized by having the converter control unit which performs armature-voltage control for making said direct current voltage in agreement with an electrical-potential-difference command value repeatedly synchronizing with the fluctuation period of supply voltage.
[0013] Invention according to claim 5 is claim 1 thru/or the drive control device of the motor of four given in any 1 term, and while the armature-voltage control which said inverter control device performs is duty control which makes the driving signal supplied to a motor a predetermined duty ratio, the electrical-potential-difference command value supplied to said converter control device is characterized by being set up so that the duty ratio of said driving signal may become less than 100%.
[0014] The armature-voltage control which invention according to claim 6 is claim 1 thru/or the drive control device of the motor of four given in any 1 term, and said inverter control device performs The electrical-potential-difference command value which is the duty control which makes the driving signal supplied to a motor a predetermined duty ratio, and is supplied to said converter control unit It is characterized by being the value which subtracted required tolerance from 100% when amending the ripple which is set up so that the duty ratio of said driving signal may serve as a predetermined value, and superimposes said predetermined value on said direct current voltage.
[0015] Invention according to claim 7 is claim 1 thru/or the drive control unit of the motor of six given in any 1 term. While having the ripple amendment section which calculates the ripple correction value for offsetting the electrical-potential-difference ripple which originates in a powerline period and is superimposed on said direct current voltage based on the load of a motor Said inverter control unit is characterized by performing amendment for preventing that the effect of the electrical-potential-difference ripple resulting from a powerline period attains to a motor based on said ripple correction value.
[0016] Invention according to claim 8 is the drive control device of a motor according to claim 7, and said ripple amendment section is characterized by detecting the load of a motor based on the engine speed of a motor, and the output voltage of said inverter.
[0017] Invention according to claim 9 is the drive control device of a motor according to claim 7, and said ripple amendment section is characterized by detecting the load of a motor based on the input current which flows into a converter from AC power supply.
[0018] Invention according to claim 10 is the drive control device of a motor according to claim 7, and said ripple amendment section is characterized by detecting the load of a motor based on said direct current voltage outputted from a converter, and the rotational frequency of a motor.
[0019] Invention according to claim 11 is claim 1 thru/or the drive control device of the motor of ten given in any 1 term, and when changing the output command value of said inverter control device in

predetermined time, it is characterized by having the control gain controller which changes the control gain of the armature-voltage control by said converter control device so that the output command value may be stabilized.
[0020] Invention according to claim 12 is claim 1 thru/or the drive control device of the motor of ten given in any 1 term, and when changing the output command value of said inverter control device in predetermined time, it is characterized by having the control output-value amendment section which amends to the output command value of said converter control device so that the output command value may be stabilized.
[0021] Invention according to claim 13 is claim 1 thru/or the drive control unit of the motor of 12 given in any 1 term, and it is characterized by said motor being the driving source of a compressor.
[0022]
[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained with reference to a drawing. In addition, the explanation which gives the same sign to the element which is common in each drawing, and overlaps is omitted.
[0023] Gestalt 1. drawing 1 of operation shows the circuit block diagram of the drive control device of the motor of the gestalt 1 of operation of this invention. For a noise filter and 30, as for a smoothing capacitor and 20, in drawing 1 , a converter and 18 are [10 / AC power supply and 12 / an inverter and 22] motors. The converter 30 is equipped with a diode bridge 14, a reactor 24, a switching element 26, and the diode 28 for antisuckbacks. Moreover, in drawing 1 , the powerline-period detecting element to which 32 detects the fluctuation period of supply voltage, the converter control device with which 34 controls a converter 30, and 36 are inverter control devices which control an inverter 20.
[0024] The powerline-period detecting element 32 is constituted by the supply voltage zero cross detector with which the drive control unit of a motor is generally equipped. A zero cross detector is a circuit used in order to distinguish whether a power line period is generally 50 [Hz] or it is 60 [Hz], for example, in case supply voltage passes through about 0V, the photo coupler which will be in an ON (or OFF) condition can realize it easily. According to using a zero cross detector, a powerline-period detecting element can be realized, without being accompanied by cost rise. The detection result of the powerline-period detecting element 32 is supplied to the converter control unit 34.
[0025] Drawing 2 shows the block diagram of the converter control device 34. The converter control device 34 is equipped with the feedback control section 38. The feedback control section 38 is equipped with the direct-current-voltage detecting element 40. The direct-current-voltage detecting element 40 detects the direct current voltage VDC outputted from a converter 30, i.e., the direct current voltage which appears in the both ends of a smoothing capacitor 18. The detection result (a "direct-current-voltage detection value" is called hereafter) of the direct-current-voltage detecting element 40 is supplied to the electrical-potential-difference PI control section 42.
[0026] The direct-current-voltage command value is supplied to the electrical-potential-difference PI control section 42 from the inverter control circuit 36 with the direct-current-voltage detection value. The electrical-potential-difference PI control section 42 calculates the deflection of a direct-current-voltage detection value and a direct-current-voltage command value, and supplies the value to the proportional operation part 44 and the integral term operation part 46. The proportional operation part 44 and the integral term operation part 46 calculate the feedback proportional Kv1 and the feedback integral terms Kv2/S, respectively. The feedback proportional Kv1 and the feedback integral terms Kv2/S are supplied to the post-multiplication section 48 added mutually.
[0027] Sinusoidal signal sintheta is supplied to the multiplication section 48 from the sinusoidal generation section 50 with Kv1 and the addition result of Kv2/S. The detection result about the period of supply voltage and the zero cross signal specifically emitted whenever supply voltage crosses 0V are supplied to the sinusoidal generation section 50 from the powerline-period detecting element 32 mentioned above. The sinusoidal generation section 50 generates sinusoidal signal sintheta which changes with the same phase as supply voltage based on the zero cross signal, and supplies the signal sintheta to the multiplication section 48.
[0028] The multiplication section 48 calculates a current command value by multiplying Kv1, the addition result of Kv2/S, and sinusoidal signal sintheta. According to the above-mentioned processing, the current command value in which the both sides of the deflection of direct current voltage VDC and a direct-current-voltage command value and the phase of supply voltage were reflected is generable.
[0029] The current command value generated by the multiplication section 48 is supplied to the current PI control section 52. The detection value of an input current IIN is supplied to the current PI control section 52 from the input current detecting element 54 with the above-mentioned current command value. The input

current detecting element 54 is a circuit which detects the input current IIN which flows into a converter 30 through a diode bridge 14 from AC power supply 10. The current PI control section 52 calculates the deflection of the current command value supplied from the multiplication section 48, and the detection value of an input current INN, and supplies the value to the proportional operation part 56 and the integral term operation part 58. The proportional operation part 56 and the integral term operation part 58 calculate the feedback proportional Ki1 and the feedback integral terms Ki2/S, respectively.

[0030] After the feedback proportional Ki1 and the feedback integral terms Ki2/S are added mutually, they are supplied to the Tr mechanical component 60 as an PWM output value. The Tr mechanical component 60 is a circuit which supplies the driving signal which has a duty ratio according to the PWM signal supplied from the current PI control section 52 to a switching element 26. In this operation gestalt, with the above-mentioned driving signal, i.e., the driving signal which has a duty ratio according to a current command value and deflection with an input current INN, a switching element 26 is driven so that both deflection may become small.

[0031] The converter control unit 34 is equipped with the control initiation command section 62 as shown in drawing 2 . The control initiation command section 62 requires initiation of feedback control from the feedback control section 38 of the converter control device 34 to predetermined timing. The feedback control section 38 processes detection (direct-current-voltage detecting element 40) of direct current voltage VDC, the operation (multiplication section 48) of a current command value, detection (input current detecting element 54) of an input current INN, the output (current PI control section 52) of an PWM output value, etc. promptly, after initiation of control is required from the control initiation command section 62. For this reason, the control pattern of a switching element 26 changes, whenever a control initiation command is emitted from the control initiation command section 62. Moreover, the control initiation headquarters 62 can also emit the command which carries out initiation of the electrical-potential-difference PI control section 42 and the current PI control section 52 of operation according to an individual.

[0032] The converter control device 34 is equipped with the synchronous timing generating section 64 in the drive control device of this operation gestalt. The synchronous timing generating section 64 generates a synchronizing signal to predetermined timing, after a control initiation command is emitted from the control initiation command section 62. The synchronizing signal emitted by the synchronous timing generating section 64 is supplied to the inverter control circuit 36. The drive control device of this operation gestalt has the 1st description at the point that a synchronizing signal is emitted from the converter control device 34 to the inverter control device 36, whenever the converter control device 34 newly starts feedback control like the above.

[0033] Drawing 3 shows the block diagram of the inverter control device 36. The inverter control device 36 is equipped with the feedback control section 66. The feedback control section 66 is equipped with the direct-current-voltage detecting element 68, the PWM signal generation section 70, the rotation location detecting element 72, the rotational frequency detecting element 76, and the deflection detecting element 78. The direct-current-voltage detecting element 68 detects the direct current voltage VDC which appears in the both ends of a smoothing capacitor 18, and supplies the value to the PWM signal generation section 70.

[0034] The rotator location detecting element 72 detects the location of the rotator of a motor 22, and supplies the result to the rotational frequency detecting element 76. The rotational frequency detecting element 76 detects the rotational frequency of a motor 22 based on change of the location of a rotator, and supplies the result to the deflection detecting element 78. While the actual measurement of a rotational frequency is supplied from the rotational frequency detecting element 76, the command value of a rotational frequency is supplied to the deflection detecting element 78 from the exterior. The deflection detecting element 78 is supplied to the PWM signal generation section 70 which detected and mentioned those deflection above.

[0035] Based on the engine-speed deflection supplied from the deflection detecting element 78, and the value of the direct current VDC currently supplied to the inverter 20, the PWM signal generation section 70 generates a suitable PWM signal, when making engine-speed deflection small. The motor 22 is constituted by the three-phase-circuit direct-current brushless motor in this operation gestalt. Therefore, in order to drive a motor 22, it is required to supply a driving signal appropriately to the phase corresponding to the location of the rotator detected from the rotator location detecting element 72 which should be energized. If a direct-current-voltage detection value and engine-speed deflection are detected, the PWM signal generation section 70 will control an inverter 20 so that the driving signal which has a duty ratio according to the above-mentioned PWM signal is supplied to the suitable phase of a motor 22.

[0036] The PWM signal generated by the PWM signal generation section 70 is supplied also to the command electrical-potential-difference generation section 80. The command electrical-potential-difference

generation section 80 supplies the set-up command electrical potential difference to the converter control unit 34 mentioned above as a direct-current-voltage command value while setting up the command electrical potential difference to the direct current voltage VDC supplied to an inverter 20, i.e., the command electrical potential difference to the direct current voltage VDC emitted from a converter 30, based on the above-mentioned PWM signal.

[0037] When the PWM signal generated by the PWM signal generation section 70 is a thing corresponding to a low duty ratio as compared with a predetermined value, the command electrical-potential-difference generation section 80 judges that the direct current voltage VDC currently supplied to the inverter 20 is high pressure beyond the need, and, more specifically, updates a direct-current-voltage command value to a smaller value. Moreover, when the PWM signal generated by the PWM signal generation section 70 is a thing corresponding to the duty ratio exceeding 100%, the command electrical-potential-difference generation section 80 judges that the direct current voltage VDC currently supplied to the inverter 20 is insufficient, and updates a direct-current-voltage command value to a bigger value. If the above-mentioned control is performed by the command electrical-potential-difference generation section 80, the duty ratio of the driving signal supplied to a motor 22 from an inverter 20 is maintainable to an always big value.

[0038] The inverter control unit 36 is further equipped with the control initiation command section 82. The control initiation command section 82 requires initiation of feedback control from the feedback control section 66 to predetermined timing. The feedback control section 66 processes detection (direct-current-voltage detecting element 68) of direct current voltage VDC, generation (PWM signal generation section 70) of an PWM signal, etc. promptly, after initiation of control is required from the control initiation command section 82. For this reason, the pattern of the driving signal supplied to a motor 22 from an inverter 20 changes, whenever a control initiation command is emitted from the control initiation command section 82.

[0039] In the drive control device of this operation gestalt, the synchronizing signal which the synchronous timing generating section 64 of the converter control device 34 emits is supplied to the control initiation command section 82 of the inverter control device 36. The drive control device of this operation gestalt has the 2nd description in response to the synchronizing signal with which the control initiation command section 82 was emitted from the converter control device 34 at the point which emits a control initiation command in the feedback control section 66 of the converter control device 36.

[0040] Next, actuation of the drive control unit shown in drawing 1 is explained. In the drive control device of this operation gestalt, a converter 30 performs control for making mostly into the shape of a sine wave the input current IIN which flows into a converter 30 from AC power supply 10 for the purpose of improvement in a power-factor. The above-mentioned control is realized by making a switching element 26 open and close suitably.

[0041] That is, in the drive control device of this operation gestalt, if a switching element 26 is made into an ON state, a diode bridge 14, a reactor 24, and the closed circuit that short-circuits AC power supply 1 by the switching element 26 will be formed. For this reason, if a switching element 26 will be in an ON state, a current will flow to a reactor 24 and energy will be stored in a reactor 24. If a switching element 26 is made into an OFF state under the situation that the current is circulating to the reactor 24, a reactor 24 will act to continue passing the aftercurrent. Consequently, after a switching element 26 is turned off, a current continues circulating to a diode bridge 14 and a reactor 24, and the current flows into a smoothing capacitor 18 through the antisuckback diode 28. The current which flows into a converter 30 from AC power supply 10 decreases as the energy currently stored in the reactor 24 decreases.

[0042] For this reason, the amount of currents which flows into a converter 30 from AC power supply 10 can be made to fluctuate in the shape of a sine wave mostly by controlling a switching element 26 suitably. Drawing 4 (A) and drawing 4 (B) show the wave of the input voltage generated between the output terminals of a diode bridge 14, and the wave of an input current IIN realized by controlling a switching element 26 suitably, respectively. According to the drive control unit of this operation gestalt, it can consider as the value of a request of direct current voltage VDC by changing the amplitude of an input current shown in drawing 4 (B). In addition, actuation of the converter 30 mentioned above is general actuation of a well-known pressure-up converter.

[0043] Next, actuation of an inverter 20 is explained. Like ****, the direct-current brushless motor is used for the motor 22 in this operation gestalt. In this case, in order to rotate a motor 22, it is required to control the phase which should be energized in a motor 22, and the power which should be supplied to a motor 22 by the inverter 20 side. Generally PWM control is used for control of a direct-current brushless motor. The engine speed of a direct-current brushless motor rises, when the duty ratio of a driving signal increases, and when the duty ratio falls, it falls. An inverter 20 and the inverter control unit 36 control the rotational

frequency of a motor 22 using the above-mentioned property. In addition, the actuation mentioned above is the drive approach of a brushless motor generally learned.

[0044] Drawing 5 shows the wave of the driving signal outputted to the plane 1 of a motor 22 from an inverter 20. As shown in drawing 5 , generally 2 phase modulation of an PWM period and the full energization period is established [they combine them and] and carried out at the drive pattern of a motor 22. 2 phase modulation is the well-known technique of decreasing the count of switching in an inverter 20, and reducing loss of an inverter 20. Furthermore, a motor 22 and since especially a brushless motor is driven efficiently, an efficient drive is realizable by reducing RF loss with a motor 22 using a high duty ratio in an PWM period.

[0045] Like ****, the technique of making the duty ratio of the driving signal supplied to a motor 22 from an inverter 20 as technique by which the drive control device of this operation gestalt controls the engine speed of a motor 22 fluctuate, and the technique of making the command value of the direct current voltage VDC supplied to an inverter 20 fluctuate so that the duty ratio may be held at an always high value were combined, and it has adopted. For this reason, according to the drive control device of this operation gestalt, the duty ratio of the driving signal supplied to a motor 22 can be held to a high value, and the rotational frequency of a motor 22 can be controlled efficiently.

[0046] However, when a driving signal with a high duty ratio is supplied to a motor 22, the effect of the electrical-potential-difference ripple superimposed on direct current voltage VCD is greatly reflected in the driving signal. For this reason, in supplying a driving signal with a high duty ratio to a motor 22, it becomes easy to make the noise which originates in the ripple of direct current voltage VCD, and originates in the rotation nonuniformity and its rotation nonuniformity of a motor 22. According to the converter 30, the electrical-potential-difference ripple resulting from a powerline period and the electrical-potential-difference ripple resulting from control of converter 30 self are overlapped on direct current voltage VDC. For this reason, if a motor 22 is driven by the signal with an only high duty ratio, it will originate in each of these two ripples, and two noise from which a period differs will generate it.

[0047] Then, by synchronizing the converter control device 34 and the inverter control device 36, the drive control device of this operation gestalt makes a converter 30 and an inverter 20 cooperate, and is presupposing that it prevents that the electrical-potential-difference ripple resulting from control of the converter control device 34 influences actuation of the inverter control device 36. The contents of the processing performed in order that the device which the ripple mentioned above generates hereafter, and the drive control unit of this operation gestalt may eliminate the effect of the ripple are explained.

[0048] First, the device which originates in control of a converter 30 and an electrical-potential-difference ripple generates is explained. The converter control unit 34 is equipped with the electrical-potential-difference PI control section 42 like **** (refer to drawing 2). According to the electrical-potential-difference PI control section 42, let the sum of the proportional to the deflection ("voltage deviation" is called hereafter) of direct current voltage VDC and a direct-current-voltage command value, and an integral term be the control output of armature-voltage control. Although this control output maintains the value stabilized when voltage deviation was always 0, it is impossible for always holding voltage deviation to 0. For this reason, in the converter control unit 34, the control output supplied to the multiplication section 48 serves as a signal with pulsation from the armature-voltage control section 42.

[0049] Moreover, as shown in drawing 6 , the amount of [of a power line period] ripple superimposes on the direct current voltage VDC detected as a foundation of voltage deviation. If such direct current voltage VDC is detected for every timing shown by the arrow head in drawing 6 , big pulsation will arise in the value of the direct current voltage VDC detected for every cycle. The pulsation produced in the detection value of a direct current VDC is reflected in voltage deviation, and is further reflected in the control output supplied to the multiplication section 48. Pulsation of the control output supplied to the multiplication section 48 is reflected in the PWM output value which is the output of the converter control unit 34. Moreover, pulsation of an PWM output value is reflected in the direct current voltage VDC generated by the converter 30. The electrical-potential-difference ripple which does in this way and originates in control of a converter 30 is overlapped on direct current voltage VDC.

[0050] It is possible to control a converter 30 to amend the electrical-potential-difference ripple (electrical-potential-difference ripple shown in drawing 6) generated with a power line period, for example as an approach of making small the electrical-potential-difference ripple resulting from the control mentioned above as much as possible. That is, as compared with a power line period, direct current voltage VDC is detected at a rate quick enough, and according to performing armature-voltage control at a rate quick enough, the electrical-potential-difference ripple resulting from control can be controlled small. However, in order to realize the above-mentioned control, it is required to perform current control performed in the latter

part of armature-voltage control the rate beyond armature-voltage control. It is because a current is distorted and a sine wave-like input current is no longer obtained, unless it accelerates current control. For this reason, in order to realize the above-mentioned control, it is necessary to accelerate converter control unit 34 self very much. Improvement in the speed of such a converter control unit causes [of a drive control unit] a cost rise.

[0051] Next, the electrical-potential-difference ripple superimposed on direct current voltage VDC serves as rotation nonuniformity of a motor 22, and explains the device which causes the noise. Feedback control is hung to direct current voltage VDC so that the inverter control unit 36 may detect direct current voltage VDC, may originate in fluctuation of direct current voltage VDC and the engine speed of a motor 22 may not change (refer to drawing 3). As shown in drawing 6 , even if an average electrical potential difference has the fixed inverter control unit 36, when detecting an electrical potential difference with a ripple, the situation recognized to change the average electrical potential difference depending on the detection time of direct current voltage VDC may arise. In this case, the inverter control unit 12 changes the duty ratio of an PWM signal for the purpose of maintaining the engine speed of a motor 22 to constant value. Consequently, the power of the driving signal supplied to a motor 22 changes from an inverter 20 superfluously, rotation nonuniformity arises in a motor 22, and the noise resulting from the rotation nonuniformity occurs.

[0052] Next, the device in which the drive control unit of this operation gestalt prevents above-mentioned rotation nonuniformity and the above-mentioned noise is explained. The peak (the both sides by the side of a rise and descent are included) of the electrical-potential-difference ripple resulting from control of a converter 30 usually appears, when the converter control device 34 changes the drive pattern of a switching element 26. The drive pattern of a switching element 26 changes, immediately after the converter control unit 34 starts armature-voltage control in each cycle. For this reason, the electrical-potential-difference ripple resulting from control of a converter 30 usually has the peak at the stage when the converter control unit 34 starts armature-voltage control. Therefore, according to synchronizing the armature-voltage control in the inverter control device 36 with the armature-voltage control of the converter control device 36, the electrical-potential-difference ripple resulting from control of a converter 30 can prevent affecting the direct current voltage VDC detected by the inverter control device 36.

[0053] Drawing 7 (A) and drawing 7 (B) show the wave of the direct current voltage VDC which the electrical-potential-difference ripple resulting from control of a converter 30 superimposed, respectively, and the timing by which armature-voltage control is started in the converter control unit 34. Moreover, drawing 7 (C) shows the timing to which the inverter control device 36 starts armature-voltage control, i.e., the timing which detects direct current voltage VDC, in the drive control device of this operation gestalt.

[0054] As shown in drawing 7 , in this operation gestalt, the synchronization of the initiation timing of the armature-voltage control of the converter control unit 34 and the inverter control unit 36 is achieved so that the average electrical-potential-difference value of direct current voltage VDC can be detected without influencing the inverter control unit 36 of a ripple. Specifically inside the converter control unit 34, a control initiation command is emitted from the control initiation command section 62 at the stage when armature-voltage control should be started in each cycle to the feedback control section 38 and the synchronous timing generating section 64 (refer to drawing 2). After the synchronous timing generating section 64 receives a control initiation command, it waits for progress of predetermined time and generates a synchronizing signal. In this operation gestalt, the above-mentioned predetermined time is set as the time amount taken for the direct current voltage VDC which the ripple superimposes to serve as an average electrical-potential-difference value from peak value. The synchronizing signal emitted from the synchronous timing generating section 64 is received by the control initiation command section 82 of the inverter control unit 36 (refer to drawing 3). The control initiation command section 82 will order it immediately initiation of the armature-voltage control in the feedback control section 66, if the synchronizing signal is received. Consequently, in the feedback control section 66, it is not concerned with superposition of a ripple but armature-voltage control based on the average electrical potential difference of direct current voltage VDC is performed. Therefore, the inverter control device 36 can supply a proper driving signal to a motor 22, without being influenced of the electrical-potential-difference ripple resulting from control of a converter 30.

[0055] Like ****, in the drive control device of this operation gestalt, it is constituted so that the converter control device 34 and the inverter control device 36 may open fixed time difference and may start armature-voltage control. The ripple by control of a converter 30 is premised on generating a peak for every cycle of the control for the above-mentioned setup, as shown in drawing 7 (A). When the control gain Kv1 and Kv2 shown in drawing 2 is a comparatively high value, it is easy to produce the peak of an electrical-potential-difference ripple for every cycle. On the other hand, when those control gain is comparatively small values,

the peak of an electrical-potential-difference ripple may not arise for every cycle of control. In this case, even if it establishes fixed time difference between the initiation stage of the armature-voltage control in the converter control device 34, and the initiation stage of the armature-voltage control in the inverter control device 36, in the inverter control device 36, the average electrical potential difference of direct current voltage VDC is undetectable.

[0056] In such a case, while making in agreement the initiation stage of the armature-voltage control in the converter control device 34, and the initiation stage of the armature-voltage control in the inverter control device 36, in the inverter control device 36, revolving speed control of a motor 22 can be performed with a sufficient precision by making an PWM signal generate based on the average of the direct current voltage VDC detected in two or more cycles. That is, according to the above-mentioned configuration, the inverter control unit 36 carries out direct-current-voltage VDC detection to the timing an electrical-potential-difference ripple indicates the peak by the side of a rise or descent to be at the time of initiation of armature-voltage control. According to equalizing two or more direct current voltage VDC detected to such timing, the stable detection value can be acquired. Therefore, the rotation nonuniformity and the noise of a motor 22 can be controlled effectively, without being influenced of the electrical-potential-difference ripple superimposed on direct current voltage VDC, if the inverter control unit 36 generates an PWM signal on the basis of the average.

[0057] the drive control device of this operation gestalt -- setting -- a macro computer with separate converter control device 34 and inverter control device 36 -- or a single microcomputer, single DSP, etc. can constitute. When they consist of two macro computers, both can be synchronized using the edge of a digital signal etc. by connecting these two microcomputers by the communication wire in which two-way communication is possible, and establishing every one port the object for transmission, and for reception in each microcomputer. Moreover, when the converter control device 34 and the inverter control device 36 consist of single microcomputers etc. for example, the thing for which software is constituted so that processing required for both function may be performed by the same subroutine -- or After processing of the converter control device 34 is completed, making the same time of day putting both armature-voltage control into operation or fixed time difference can be vacated, and it can be made to start by constituting software so that processing of the inverter control device 36 may be started.

[0058] According to the drive control device of this operation gestalt, the armature-voltage control period of the converter control device 34 and the armature-voltage control period of the inverter control device 36 can be synchronized, and it can be made to operate like ****. For this reason, the driving signal supplied to a motor 22 can be stabilized from stabilizing the value of the direct current voltage VDC detected by the inverter control unit 36. Therefore, according to the drive control unit of this operation gestalt, by the cheap policy, the rotation nonuniformity of a motor 22 can be controlled and reduction of the noise can be aimed at.

[0059] By the way, in the above-mentioned operation gestalt, although the armature-voltage control period of a converter 30 and the armature-voltage control period of an inverter 20 are set as 1:1, as long as both electrical-potential-difference period synchronizes, the ratio is not restricted to 1:1 and may carry out infanticide control operation which makes the control cycle of an inverter 20 1 time to two control cycles of a converter 30.

[0060] With reference to drawing 8 thru/or drawing 12 , the gestalt 2 of operation of this invention is explained with gestalt 2. of operation, next drawing 1 . Drawing 8 shows the block diagram of the converter control device 34 with which the drive control device of the gestalt 2 of operation of this invention is equipped. The drive control device of this operation gestalt is realized in the system configuration shown in above-mentioned drawing 1 by giving the configuration shown in the converter control device 34 at drawing 8 . In the converter control unit 34 shown in drawing 8 , the sinusoidal signal which the sinusoidal generation section 50 generates is supplied to the control initiation command section 62 while it is supplied to the multiplication section 48. The drive control unit of this operation gestalt has the description at the point that the control initiation command section 62 emits a control initiation command synchronizing with the fluctuation period of supply voltage based on a sinusoidal signal.

[0061] Drawing 9 shows the wave of the direct current voltage VDC which the electrical-potential-difference ripple resulting from a powerline period superimposed. Moreover, drawing 10 shows the direct current voltage VDC and an example of the timing by which armature-voltage control is started in the converter control unit 34. As shown in drawing 10 , when armature-voltage control of the converter control device 34 is performed with the fluctuation period of supply voltage, and a different period, the direct current voltage VDC detected by the converter control device 34 becomes what was greatly influenced of the ripple resulting from a powerline period. If direct current voltage VDC like a converter control unit 34

smell lever is detected, the electrical-potential-difference ripple resulting from control is newly overlapped on direct current voltage VDC like ****.

[0062] The effect of the electrical-potential-difference ripple which originates in a powerline period and is superimposed on direct current voltage VDC can be offset by the ripple resulting from control by making the converter control unit 34 perform power control a period short enough as compared with a powerline period. That is, if armature-voltage control by the converter control unit 34 is performed to the timing shown in drawing 11 (B) when the electrical-potential-difference ripple as originated in DC power supply VDC at a powerline period and shown in drawing 11 (A) has arisen, an electrical-potential-difference ripple as originated in the control and shown in drawing 11 (C) will arise. In this case, by compounding the ripple resulting from a powerline period, and the ripple resulting from control, as shown in drawing 11 (D), from direct current voltage VDC, the effect of a ripple is eliminated mostly. In addition, the arrow head drawing 11 (B) Shown shows the change direction of direct current voltage VDC demanded by the converter control unit 34. Moreover, the die length of those arrow heads shows the difference of the value of direct current voltage VDC which the converter control unit 34 requires, and the reference value of direct current voltage VDC.

[0063] However, in order to offset the electrical-potential-difference ripple resulting from a powerline period by the electrical-potential-difference ripple which originates in control like the above, it is required to perform armature-voltage control at a very quick rate by the converter control unit 34. Furthermore, although the converter control unit 34 is also performing control of an input current IIN with control of direct current voltage VDC, when only armature-voltage control is accelerated, the situation by which an input current IIN is not controlled in the shape of a sine wave proper may arise. For this reason, it is necessary to also accelerate current control collectively, and if it is going to offset the ripple resulting from a powerline period by the ripple resulting from control, the control system of the converter control unit 34 will become complicated, and it will lead to a great cost rise.

[0064] Then, in the drive control device of this operation gestalt, it is supposed that the effect of the ripple resulting from a powerline period will be controlled as synchronizing the armature-voltage control period of the converter control device 34 with the period of a power source. That is, if the converter control unit 34 performs armature-voltage control synchronizing with the period of a power source (direct current voltage VDC is detected), as shown in drawing 12 , the converter control unit 34 can detect direct current voltage VDC, without being influenced of the ripple of a power source.

[0065] In this operation gestalt, the synchronization mentioned above is fixing the stage when the converter control unit's 34 detects direct current voltage VDC at the stage when the electrical angle of a powerline period serves as a predetermined value. In this operation gestalt, in order to secure both synchronization by easy processing, supply voltage is saying making the inverter control unit 34 detect direct current voltage VDC synchronizing with the stage to intersect the zero point. that is, in the interior of the inverter control unit 34, the control initiation command section 62 will generate a control initiation command to the feedback control section 38, if the crossover with supply voltage (or the signal emitted from the powerline-period detecting element 32 -- based) and the zero point is detected based on the sinusoidal signal which the sinusoidal generation section 50 emits. The feedback control section 38 starts processing of detection of direct current voltage VDC etc. by receiving the above-mentioned control initiation command. Consequently, synchronizing with the zero cross of supply voltage, armature-voltage control in the converter control unit 34 is performed.

[0066] If direct current voltage VDC can be detected without influencing the converter control unit 34 of the electrical-potential-difference ripple resulting from a powerline period like the above, the electrical-potential-difference ripple which the control output by armature-voltage control is stable, consequently originates in control of the converter control unit 34 can be reduced. Therefore, according to the drive control unit of this operation gestalt, the rotation nonuniformity and the noise of a motor 22 can be controlled by the cheap policy, without [without it is accompanied by cost rise, and] attaining improvement in the speed of control.

[0067] By the way, in the above-mentioned operation gestalt, although carried out to synchronizing the converter control device 34 and the inverter control device 36 like the case of the gestalt 1 of operation, this invention is good also as not being limited to this and making it operate to the independent timing that the converter control device 34 and the inverter control device 36 are separate.

[0068] The gestalt 3 of operation of this invention is explained with reference to gestalt 3. next drawing 13 thru/or drawing 15 of operation. Drawing 13 shows the block diagram of the drive control device of the gestalt 3 of operation of this invention. The drive control unit of this operation gestalt has the description at the point equipped with the ripple amendment section 84, as shown in drawing 13 . The ripple amendment

section 84 is equipment for preventing that the driving signal supplied to a motor 22 from an inverter 20 pulsates under the effect of the electrical-potential-difference ripple resulting from a powerline period. The drive control device of the gestalt 1 of operation is equipment equipped with the function to reduce the effect which the electrical-potential-difference ripple resulting from control of the converter control device 34 has on an inverter 20, and the drive control device of the gestalt 2 of operation is equipment equipped with the function to reduce the effect which the electrical-potential-difference ripple resulting from a powerline period has on a converter 30. The drive control device of this operation gestalt adds the function to reduce the effect which the electrical-potential-difference ripple resulting from a powerline period has on an inverter 20 to the equipment of the gestalten 1 and 2 of operation.

[0069] Drawing 14 shows the block diagram of the ripple amendment section 84. As shown in drawing 14 , the ripple amendment section 84 is equipped with the load detecting element 86. The load detecting element 86 is a block which detects the load of a motor 22. It can ask for the load of a motor 22 as a multiplication value of the rotational frequency of a motor 22, and the output torque of a motor 22. The inverter control unit 36 is performing revolving speed control of a motor 22. For this reason, according to the drive control unit of this operation gestalt, the rotational frequency of a motor 22 can be grasped easily. Moreover, the output voltage supplied to a motor 22 is fluctuated according to the load of a motor 22 from an inverter 20. For this reason, the output torque of a motor 22 can be guessed based on the output voltage emitted from an inverter 20. In this operation gestalt, the load detecting element 86 guesses the load of a motor 22 based on the engine speed of a motor 22, and the output voltage of an inverter 20. According to the above-mentioned configuration, the load of a motor 22 can be detected, without being accompanied by cost rise.

[0070] The ripple amendment section 84 is equipped with the amendment pattern generation section 88. The amendment pattern generation section 88 is a block which generates the output pattern which offsets pulsation of the electrical-potential-difference ripple (drawing 15 (A)) resulting from a powerline period, as shown in drawing 15 (B). The electrical-potential-difference ripple which originates in a powerline period and is generated serves as a pattern according to the load of a motor 22, unless the capacity of a smoothing capacitor 18 changes. A paraphrase determines almost uniquely the pattern of the electrical-potential-difference ripple resulting from a powerline period to the load of a motor 22. Therefore, the amendment pattern for offsetting the electrical-potential-difference ripple is also uniquely determined to the load of a motor 22. In this operation gestalt, the amendment pattern generation section 88 generates an amendment pattern based on the amendment pattern table memorized beforehand and the load of the motor 22 supplied from the load detecting element 86. According to the above-mentioned processing, an amendment pattern required in order to offset the electrical-potential-difference ripple resulting from a powerline period is easily generable.

[0071] A synchronizing signal is supplied to the amendment pattern generation section 88 from the synchronous timing generating section 90. The synchronous timing generating section 90 generates a synchronizing signal synchronizing with the fluctuation period of supply voltage based on the signal supplied from the powerline-period detecting element 32. The amendment pattern generation section 88 supplies the amendment pattern for offsetting the electrical-potential-difference ripple resulting from a powerline period to the inverter control unit 36 to the timing which may offset the electrical-potential-difference ripple, after receiving the above-mentioned synchronizing signal.

[0072] In this operation gestalt, after the inverter control unit 36 amends the PWM signal generated by the PWM signal generation section 70 (refer to drawing 3) based on the amendment pattern supplied from the ripple amendment section 84, it is supplied to an inverter 20. According to the amendment pattern supplied from the ripple amendment section 84, increase and decrease of the PWM signal of amendment are carried out, and, specifically, an inverter 20 is supplied.

[0073] If the PWM signal amended like the above is supplied to an inverter 20, in case direct current voltage VDC falls under the effect of a power-source ripple, the duty ratio of a driving signal is amended in the increment direction, and when [that] reverse, a duty ratio will be amended in the reduction direction. Consequently, without being influenced by the power-source ripple of direct current voltage VDC, a motor 22 maintains the stable rotational frequency and operates. Therefore, according to the drive control unit of this operation gestalt, with a cheap configuration, the rotation nonuniformity of a motor 22 can be prevented and the noise of a motor 22 can be controlled.

[0074] According to the ripple amendment section 84, like ****, pulsation of the output of the inverter 20 resulting from a powerline period can be compensated only with amelioration of software, without adding new components. Therefore, according to the drive control device of this operation gestalt, pulsation of the output of the inverter 20 resulting from (1) powerline period is compensated. (2) Pulsation of the direct current voltage VDC resulting from a powerline period is controlled by synchronizing the converter control

unit 34 and a power line period. Furthermore, the configuration which controls the effect of the electrical-potential-difference ripple resulting from control of the (3) converter 30 by synchronizing the converter control device 34 and the inverter control device 36 is cheaply realizable.

[0075] By the way, in the above-mentioned operation gestalt, although carried out to synchronizing the converter control device 34 and the inverter control device 36, according to synchronizing the converter control device 34 with a power source, the electrical-potential-difference ripple resulting from control of a converter 30 can be controlled to some extent. For this reason, the ripple which controls the ripple resulting from control of a converter 30 by synchronizing a power source and a converter, and originates in a powerline period is good also as taking noise measures by the simple method controlled in the ripple amendment section 84. Thus, it becomes possible not to secure a communication link among both and to constitute only from having synchronized the converter control device 34 with the power source cheaply, when they consist of two microcomputers according to the configuration which does not synchronize an inverter 20 and a converter 30. However, the direction which synchronized the inverter control device 34 and the converter control device 36 is advantageous when preventing that the effect of a ripple gets across to a motor 22.

[0076] Furthermore, it is possible by synchronizing the converter control device 34 and the inverter control device 36 to realize the cure against the noise also as a configuration which controls the ripple resulting from control of a converter 30, and controls the ripple resulting from a powerline period by the ripple amendment section 84. According to the above-mentioned configuration, the processing for synchronizing the converter control unit 34 with a power source becomes unnecessary, and it becomes possible to perform amendment by the ripple amendment section 84 still with high precision. Made it however, more advantageous for the converter control unit 34 to synchronize with a power source, when preventing that the effect of a ripple gets across to a motor 22 also in this case.

[0077] By the way, in the above-mentioned operation gestalt, in order that the converter control unit 34 may control an input current IIN in the shape of a sine wave, the input current INN from AC power supply 10 is detected (refer to drawing 2). The input power to the converter control unit 34 can be guessed based on the current IIN and supply voltage. Therefore, the load of a motor 22 can also be guessed from an input current IIN. Drawing 16 shows a circuit block diagram in case the ripple compensator 36 detects the load of a motor 22 based on an input current IIN.

[0078] Furthermore, it is controlled by the drive control unit of the motor 22 which consisted of combination of a converter 30 and an inverter 20 by the minimum electrical potential difference needed when the minimum electrical potential difference 22 which needs direct current voltage VDC for the drive of a motor 22, i.e., a motor, generates desired torque. Therefore, the torque of a motor 22 can be guessed also from direct current voltage VDC. That is, the load of a motor 22 can be guessed based on the value of the direct current voltage VDC controlled by the converter control unit 34, and the rotational frequency of a motor 22. Drawing 17 shows a circuit block diagram in case the ripple amendment section 84 guesses the load of a motor 22 by the above-mentioned technique.

[0079] The gestalt 4 of operation of this invention is explained with reference to gestalt 4. of operation, next drawing 18 . Drawing 18 shows the block diagram of the drive control device of the gestalt 4 of operation of this invention. As shown in drawing 18 , the drive control unit of this operation gestalt is equipped with the control gain controller 92. The control gain controller 92 is a block which adjusts the control gain of the converter control device 34, when changing the control output of the inverter control device 36 in fixed time amount set up beforehand.

[0080] The output voltage of an inverter 20 may be rippled also in the gestalt 1 of operation thru/or the drive control unit of 3. In such a case, the drive control unit of this operation gestalt changes the constant of the gain Kv1 of the proportional used in the electrical-potential-difference PI control section 42 (refer to drawing 4), and the gain Kv2 of an integral term. Between fixed time amount set up beforehand, specifically, the inverter control device 36 outputs gain modification directions to the control gain controller 92, when changing continuously the control-output command value (PWM signal) over an inverter 20. If the above-mentioned directions are outputted, the control gain controller 92 and the converter control unit 34 will perform processing for changing the control gain Kv1 and Kv2.

[0081] In the drive control device of this operation gestalt, the control gain to change is restricted only to electrical-potential-difference PI control section 42 gain of the converter control device 34. In the converter control unit 34, if the gain of the current PI control section 52 is too high, un-arranging -- an oscillation arises in an input current IIN -- will arise. On the other hand, if the gain is too low, it will become difficult to control an input current IIN in the shape of a sine wave proper. On the other hand, even if the value is too high or it is too low about the gain used in the electrical-potential-difference PI control section 42, a

problem substantial only by the period of the ripple resulting from control becoming early or late is not produced. For this reason, in this operation gestalt, it excepts from the object of modification of the gain used for current control, and is considering as the object of modification of only the gain used for armature-voltage control.

[0082] The proportional used for armature-voltage control has big effect on the speed of response of the control to fluctuation of direct current voltage VDC. Therefore, if the gain Kv1 of a proportional is too large, a big control output will be generated to slight voltage deviation, and it originates in control of the converter control unit 34, and becomes easy to produce a big electrical-potential-difference ripple. For this reason, in the drive control unit of this operation gestalt, the control gain controller 92 operates so that the control gain Kv1 of a proportional may not serve as a big value unfairly.

[0083] When changing with the period which operated so that gain Kv1 of a proportional might be made into a small value, and the output command value made concrete slowly in the inverter control unit 36 in the inverter control unit 36 when changing an output command value (PWM signal) a quick period, the control gain controller 92 operates so that gain Kv2 of an integral term may be made into a big value. According to adding the control gain controller 92 like the drive control unit of this operation gestalt, rotation nonuniformity of the motor 22 resulting from the electrical-potential-difference ripple which cannot be removed only by synchronizing the period of control can be made still smaller, and a motor 22 can be more effectively formed into the low noise.

[0084] In addition, in the above-mentioned operation gestalt, the PWM signal outputted from the inverter control unit 36 is equivalent to said the "output command value" according to claim 11.

[0085] The gestalt 5 of operation of this invention is explained with reference to gestalt 5. next drawing 19 , and drawing 20 of operation. Drawing 19 shows the block diagram of the drive control device of the gestalt 5 of operation of this invention. As shown in drawing 19 , the drive control unit of this operation gestalt is equipped with the control output-value amendment section 94. The control output-value amendment section 94 is a block which adds amendment to the control output of the converter control device 34 in order to stabilize the direct current voltage VDC outputted from a converter 30.

[0086] Drawing 20 shows drawing which extracted and expressed the circumference of the electrical-potential-difference PI control section 42 of the converter control device 34 with which the drive control device of this operation gestalt is equipped. As shown in drawing 20 , before a direct-current-voltage command value (command value emitted by the inverter control device 36) is compared with a direct-current-voltage detection value (VDC), in the drive control device of this operation gestalt, correction value is added to a direct-current-voltage command value in the electrical-potential-difference PI control section 42. According to such PI control, processing for stabilizing direct current voltage VDC in a different value from the desired value of the inverter control unit 36 is performed.

[0087] If an electrical potential difference which offsets the ripple superimposed on the output voltage of an inverter 20 can be made to output to a converter 30, even if it cannot ****** an electrical-potential-difference ripple completely by the inverter control unit 36 and the ripple amendment section 84, the rotation nonuniformity of a motor 22 can be controlled effectively. In the drive control unit of this operation gestalt, the control output-value amendment section 94 inputs correction value into the electrical-potential-difference PI control section 42 of the converter control unit 34 so that the electrical-potential-difference ripple superimposed on direct current voltage VDC may become small. In this case, it becomes possible to amend an electrical-potential-difference ripple in 2nd order, to control the ripple of the electrical potential difference outputted from an inverter 20, and to drive a motor 22 to stability.

[0088] It becomes possible to drive a motor 22 to stability, without constituting the perfect ripple amendment section 84 by adding the control output-value amendment section 94 like **** according to the drive control unit of this operation gestalt. For this reason, according to the drive control unit of this operation gestalt, the function which controls the rotation nonuniformity of a motor 22 and fully controls the noise of a motor 22 is cheaply realizable.

[0089] By the way, in the above-mentioned operation gestalt, although [the correction value outputted from the control correction value amendment section 94] added to a direct-current-voltage command value, the object which applies correction value is not limited to this. That is, correction value is good also as adding to the control output of the electrical-potential-difference PI control section 42, just before being inputted into a multiplier 48, and still better also as adding to the output value outputted from the multiplier 48. In addition, because it was easiest to apply correction value in the foremost stage of control block, in the above-mentioned operation gestalt, it considered as the configuration which applies correction value to a direct-current-voltage command value.

[0090] When applying correction value by the control output-value amendment section 94 and amending an

electrical-potential-difference ripple, distortion may arise in the input current IIN currently controlled by the converter control unit 34. For this reason, it is appropriate for the amendment by the control output-value amendment section 94 to use for extent which assists the ripple amendment section 84. By considering as such a configuration, a desired amendment function can be obtained by low cost as compared with the case where the control output-value amendment section 94 is used independently.

[0091] In addition, in the above-mentioned operation gestalt, while the PWM signal outputted from the inverter control device 36 is equivalent to said the "output command value of an inverter control device" according to claim 12, the PWM output value outputted from the converter control device 34 is equivalent to said the "output command value of a converter control device" according to claim 12.

[0092] The gestalt 6 of operation of this invention is explained with reference to gestalt 6. next drawing 21 thru/or drawing 23 of operation. Drawing 21 shows the circuit block diagram of the drive control device of the gestalt 6 of operation of this invention. the drive control device of this operation gestalt made an application change of the circuit block shown in drawing 13 for the drive of a compressor 96 -- it is. A compressor 96 is used for a room air conditioner, a refrigerator, etc., and is equipped with the direct-current brushless motor.

[0093] In order to drive a direct-current brushless motor, it is necessary to energize to the phase according to the location of a rotator like ****. The inverter control unit 36 detects the location of a rotator in the rotator location detecting element 72 (refer to drawing 3), and determines the phase energized based on the detection value. Since the interior of a compressor is elevated-temperature high pressure, the location detection sensor suitable for such an environment does not exist. For this reason, the rotator location detecting element has taken in the method which detects a location without a position sensor, such as detecting the induced voltage of DC brushless motor. Generally as such a detection method, the method which compares the terminal voltage and the inverter virtual neutral point of a motor is used, for example.

[0094] In the drive control device of this operation gestalt, the signal for synchronizing mutual control etc. is usually delivered between the converter control device 34 and the inverter control device 36 and received during operation. Moreover, when an overcurrent, an overvoltage, etc. arise inside the converter control device 34, for example, the signal which shows the situation of protected operation between the converter control device 34 and the inverter control device 36 is delivered and received.

[0095] In the drive control device of this operation gestalt, when the duty ratio of the driving signal supplied to a compressor 96 from an inverter 20 is made into maximum, i.e., 100%, the wave of the driving signal comes to be shown in drawing 22 . It is easy to make the noise by the electrical-potential-difference ripple to which such a wave originates in a powerline period like **** under the situation that a compressor 96 is supplied from an inverter 20 from the direct-current brushless motor of a compressor 96.

[0096] The drive control device of this operation gestalt can realize the effective cure against the noise cheaply using the function of the ripple amendment section 84 with which the inverter control device 36 is equipped, driving the direct-current brushless motor of a compressor 96 efficient. By the way, in order to use the function of the ripple amendment section 84, it is required for the duty ratio of a driving signal to leave behind the room of fluctuation. For this reason, the driving gear of this operation gestalt performs drive control of a compressor 96, always maintaining a duty ratio to about 95%. In this case, the wave of the driving signal supplied to a compressor 96 comes to be shown in drawing 23 .

[0097] Moreover, in the drive control device of this operation gestalt, control of the engine speed of a compressor 96 or a burden controls direct current voltage VDC by the converter 30, and is performed by changing the electrical potential difference impressed to the direct-current brushless motor of a compressor 96. In the applied voltage to a direct-current brushless motor, about 5% of allowances always occur by carrying out like this. Consequently, it becomes possible to utilize the ripple amendment section 84 effectively. Thus, the function to drive a compressor 96 at high effectiveness is realizable, realizing the effective cure against the noise with a cheap configuration by controlling a converter 30 so that the duty ratio which deducted the tolerance, and the direct current voltage VDC to adjust may arise, while giving the tolerance of a duty ratio required in order to utilize the ripple amendment section 84 for the driving signal supplied to a compressor 96 according to the drive control unit of this operation gestalt.

[0098] By the way, in the above-mentioned operation gestalt, although the duty ratio of a driving signal was temporarily made into 95%, when the tolerance of the ripple amendment in an inverter 20 is required 5% or more, it is good also considering the value as a value smaller than 95%.

[0099] Moreover, in the above-mentioned operation gestalt, although the compressor 96 is set as the target driven with a drive control unit, the object of a drive is not limited to this. That is, the technique of this invention can be applied to all the products that have adopted the direct-current brushless motor, for example, can be developed also to industrial devices, such as an elevator.

[0100] Furthermore, in the above-mentioned operation gestalt, although control of an electrical-potential-difference ripple is aimed at only using the ripple amendment section 84, it is good also as using the control gain controller 92 or control output-value amendment section 94 grade with the ripple amendment section 84.

[0101]

[Effect of the Invention] Since this invention is constituted as explained above, effectiveness as taken below is done so. According to invention according to claim 1, the period of the armature-voltage control by the converter control device and the period of the armature-voltage control by the inverter control device can be synchronized. If carried out by both armature-voltage control synchronizing, even when the electrical-potential-difference ripple resulting from the armature-voltage control of a converter control device is overlapped on direct current voltage, an inverter control device can detect direct current voltage proper, without being influenced of the electrical-potential-difference ripple. For this reason, according to this invention, the electrical-potential-difference ripple resulting from control of a converter control unit can control the effect which it has on control of a motor, and can control the rotation nonuniformity and the noise of a motor effectively by the cheap policy.

[0102] According to invention according to claim 2, an inverter control unit can be made to detect the average electrical potential difference of direct current voltage. For this reason, according to this invention, it cannot be concerned with the electrical-potential-difference ripple resulting from control of a converter control unit, but a motor can be controlled with a sufficient precision.

[0103] According to invention according to claim 3 or 4, the armature-voltage control and the fluctuation period of supply voltage by the converter control unit can be synchronized. If those periods synchronize, even when the electrical-potential-difference ripple resulting from a powerline period is overlapped on direct current voltage, a converter control unit can detect direct current voltage proper, without being influenced of the electrical-potential-difference ripple. Moreover, according to this invention, two beats resulting from the control period of a converter control device and the fluctuation period of supply voltage can be summarized to one beat, without being accompanied by improvement in the speed of a cost rise and control. For this reason, according to this invention, the rotation nonuniformity and the noise of a motor can be effectively controlled by the cheap policy.

[0104] According to invention according to claim 5 or 6, the drive condition of a motor is controllable with a sufficient precision by carrying out duty control of the driving signal supplied to a motor. Moreover, according to this invention, direct current voltage is suitably controlled by the converter control unit so that the duty ratio of the driving signal serves as less than 100% of suitable value. Consequently, tolerance required for the duty ratio of a driving signal in order to amend a part for the ripple of direct current voltage is given. Therefore, according to this invention, a suitable condition is realizable when preventing that the effect of the ripple superimposed on direct current voltage attains to the operating state of a motor.

[0105] According to invention according to claim 7, the effect of the electrical-potential-difference ripple resulting from a powerline period can be further controlled by adding the ripple amendment section. Since the ripple amendment section is realizable only by modification of software, this invention can be realized without being accompanied by cost rise.

[0106] According to invention according to claim 8 to 10, the load of a motor is correctly detectable with a cheap configuration, respectively. For this reason, according to this invention, the function of the ripple amendment section is cheaply realizable.

[0107] According to invention according to claim 11, when the output command value inside an inverter control device is unstable, the control gain which a converter control device uses by the control gain controller can be changed. For this reason, according to this invention, rotation nonuniformity of the motor resulting from the electrical-potential-difference ripple which remains in direct current voltage can be made still smaller, and the silence of a motor can be raised further.

[0108] According to invention according to claim 12, correction value can be applied to the control-command value of a converter control device when the output command value inside an inverter control-device value is unstable. For this reason, according to this invention, rotation nonuniformity of the motor resulting from the electrical-potential-difference ripple which remains in direct current voltage can be made still smaller, and the silence of a motor can be raised further.

[0109] According to invention according to claim 13, a compressor can be driven efficiently, securing the outstanding silence using the drive control device of the motor which has an above-mentioned converter control device and an above-mentioned inverter control device.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the drive control device of the gestalt 1 of operation of this invention.
[Drawing 2] It is the block diagram of the converter control device shown in drawing 1 .
[Drawing 3] It is the block diagram of the inverter control device shown in drawing 1 .
[Drawing 4] It is the wave of the input voltage generated inside the converter control unit shown in drawing 1 , and an input current.
[Drawing 5] It is drawing showing the wave of the driving signal supplied to one phase of a motor from the inverter control unit shown in drawing 1 .
[Drawing 6] It is drawing showing the electrical-potential-difference ripple resulting from the powerline period shown in drawing 1 , and electrical-potential-difference detection timing.
[Drawing 7] It is drawing showing the timing by which armature-voltage control is started in the wave, converter control device, and inverter control device of the direct current voltage which the electrical-potential-difference ripple resulting from control by the converter control device shown in drawing 1 superimposed.
[Drawing 8] It is the block diagram of the converter control device with which the drive control device of the gestalt 2 of operation of this invention is equipped.
[Drawing 9] It is drawing showing the wave of the direct current voltage which the electrical-potential-difference ripple resulting from a powerline period superimposed.
[Drawing 10] A converter control unit is drawing showing an example (example of contrast over the gestalt of operation) of the timing which starts armature-voltage control.
[Drawing 11] It is drawing for explaining actuation in case a converter control unit performs armature-voltage control at high speed.
[Drawing 12] It is drawing showing the initiation timing of the armature-voltage control which a converter control device adopts in the drive control device of the gestalt 2 of operation of this invention.
[Drawing 13] It is the block diagram of the drive control device of the gestalt 3 of operation of this invention.
[Drawing 14] It is the block diagram of the ripple amendment section shown in drawing 13 .
[Drawing 15] It is drawing showing the amendment pattern generated in the ripple amendment section shown in the wave of direct current voltage and drawing 13 which the electrical-potential-difference ripple resulting from a powerline period superimposed.
[Drawing 16] It is the block diagram of the 1st modification of the drive control device of the gestalt 3 of operation of this invention.
[Drawing 17] It is the block diagram of the 2nd modification of the drive control device of the gestalt 3 of operation of this invention.
[Drawing 18] It is the block diagram of the drive control device of the gestalt 4 of operation of this invention.
[Drawing 19] It is the block diagram of the drive control device of the gestalt 5 of operation of this invention.
[Drawing 20] It is the block diagram of the amendment part of the converter control device shown in drawing 19 .
[Drawing 21] It is the block diagram of the drive control device of the gestalt 6 of operation of this invention.
[Drawing 22] It is drawing showing the wave of the driving signal of 100% of duty ratios.
[Drawing 23] It is drawing showing the wave of the driving signal used in the drive control unit shown in drawing 21 .

[Drawing 24] It is the block diagram of the drive control device of the conventional motor.
[Description of Notations]
10 AC power supply 20 Inverter 22 Motor 30 Converter 32 Powerline-period detecting element 34 Converter control device 36 inverter control device 84 Ripple amendment section 92 Control gain controller 94 Control output-value amendment section 96 Compressor.

[Translation done.]

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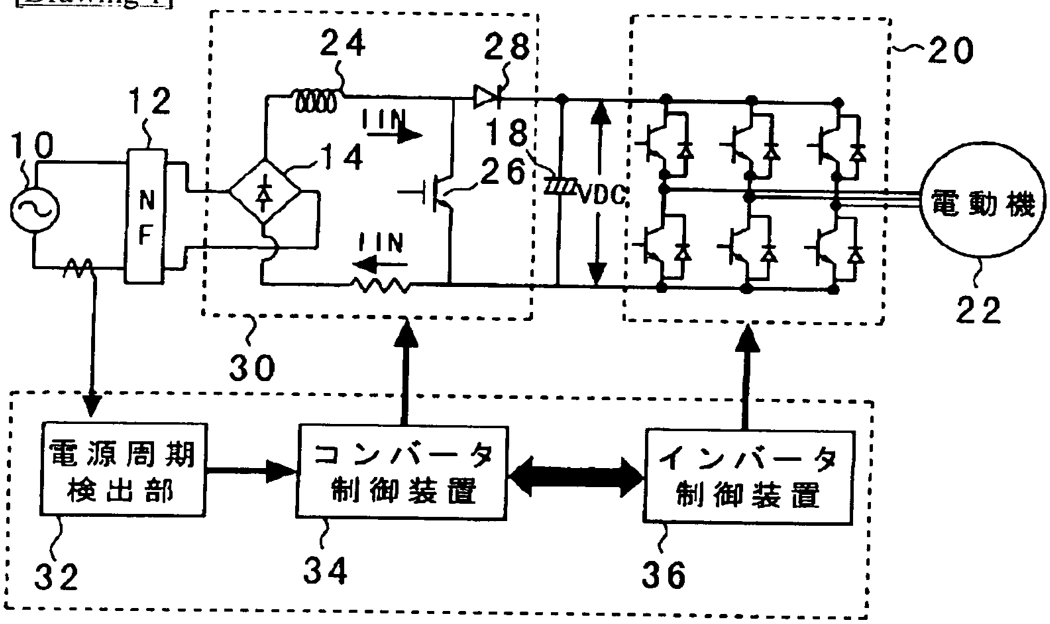
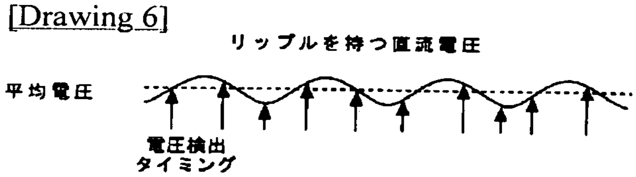
3.In the drawings, any words are not translated.

DRAWINGS

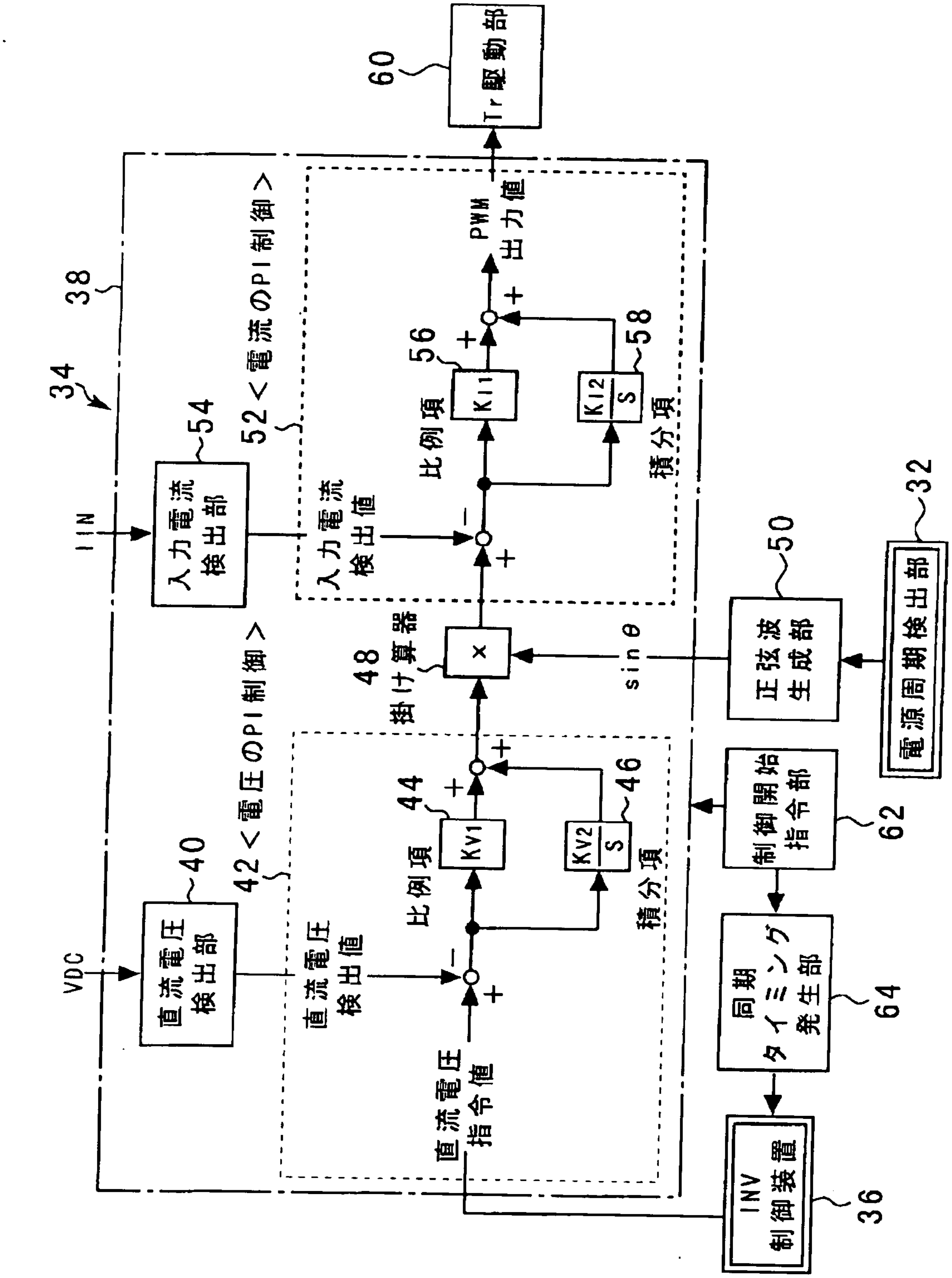
[Drawing 1]



[Drawing 6]



[Drawing 2]



Tr駆動部
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PWM
出力値
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34
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IIN
入力電流
検出部
入力電流
検出値
比例項
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KI1
KI2
S
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積分項
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正弦波
生成部
sinθ
48
掛け算器
×
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VDC
直流電圧
検出部
直流電圧
検出値
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KV2
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制御開始
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発生部
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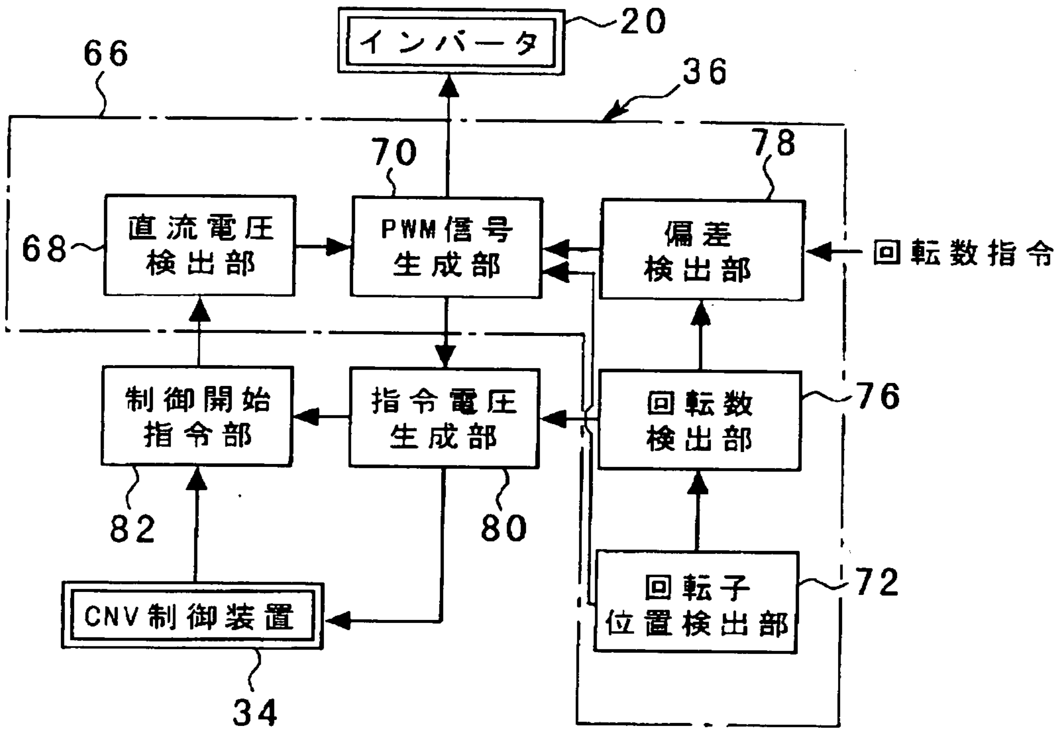
INV
制御装置

[Drawing 3]



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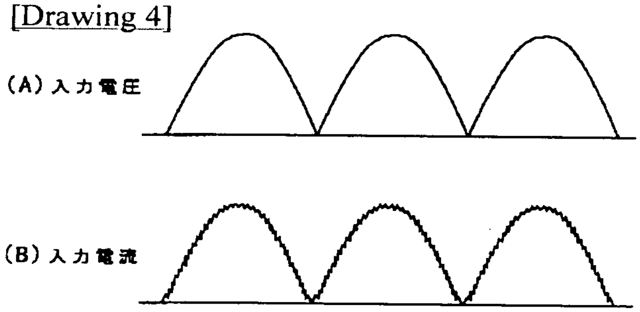

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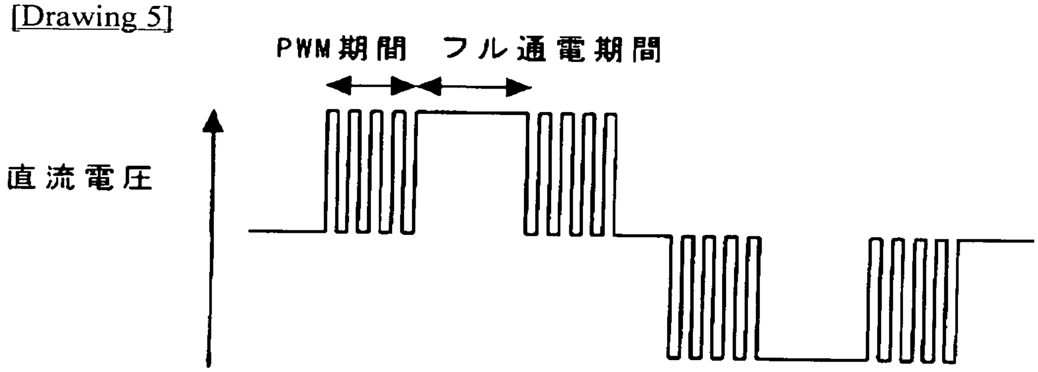

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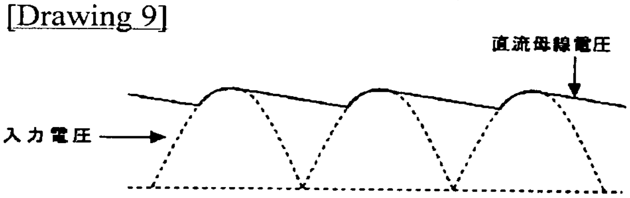

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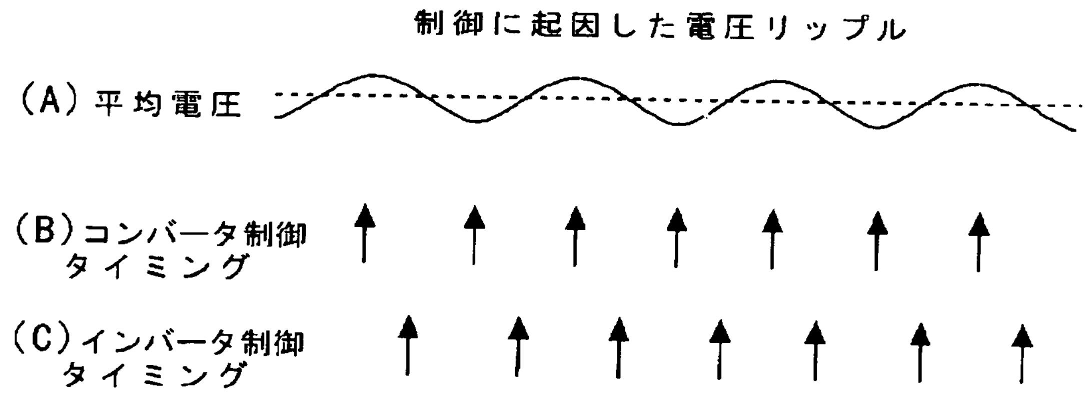
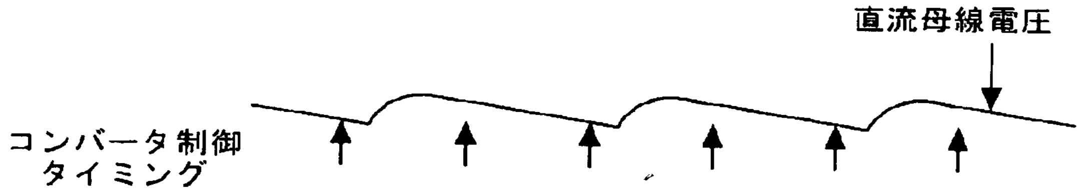
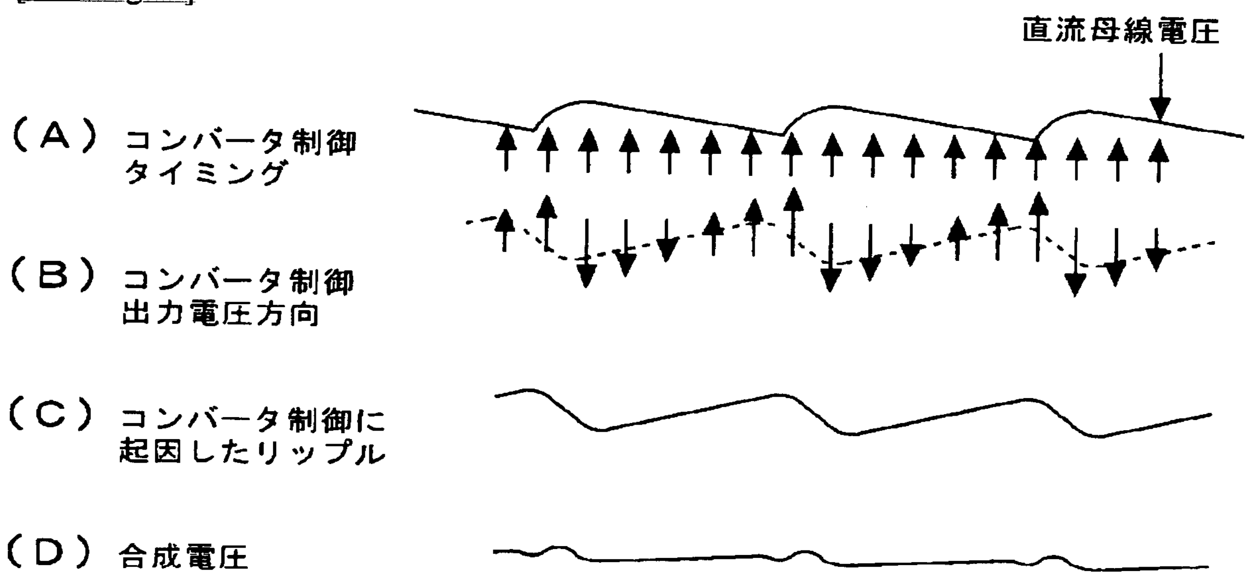


[Drawing 10]



[Drawing 11]



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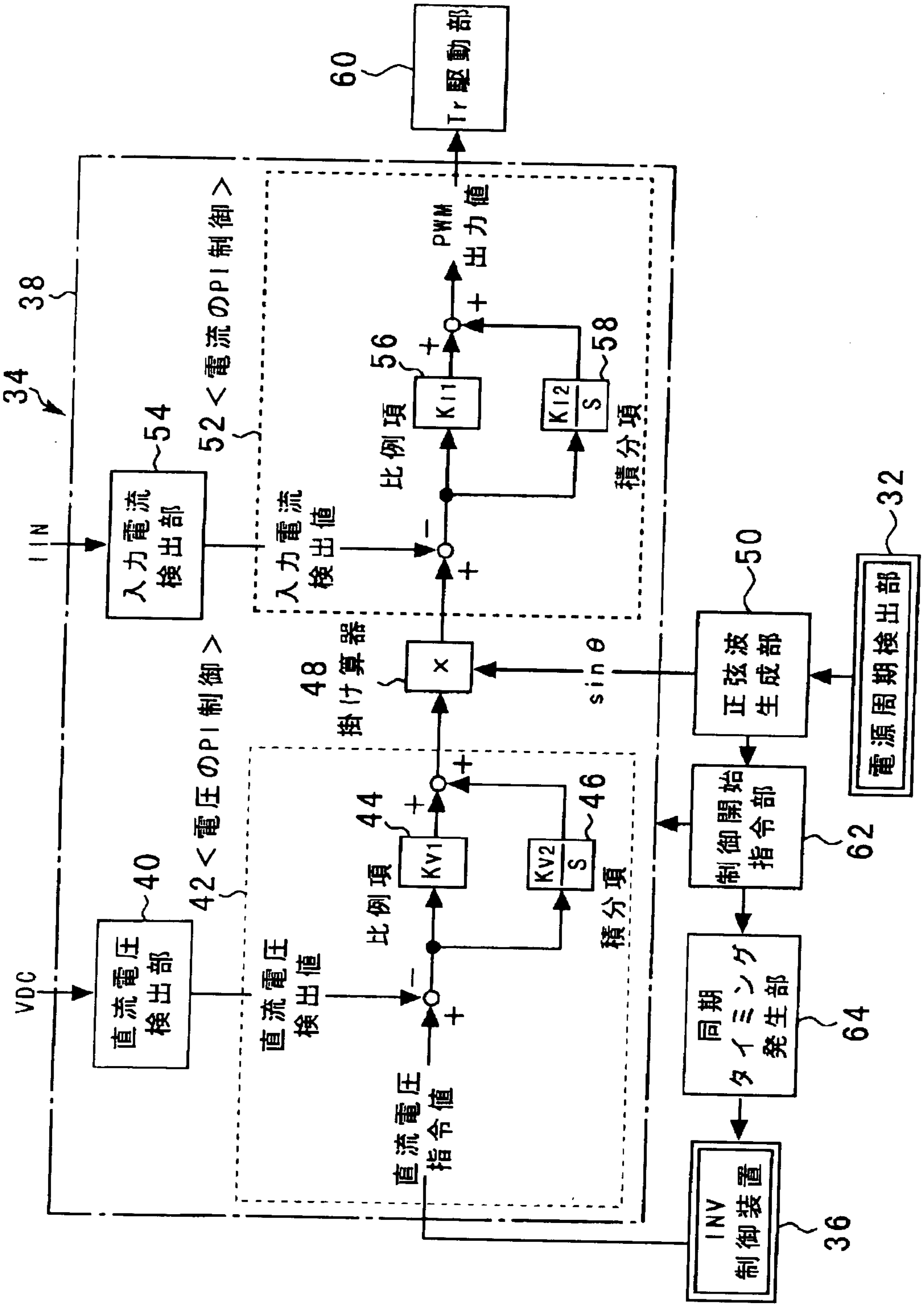

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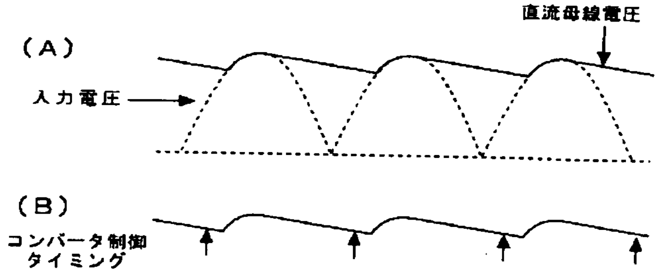

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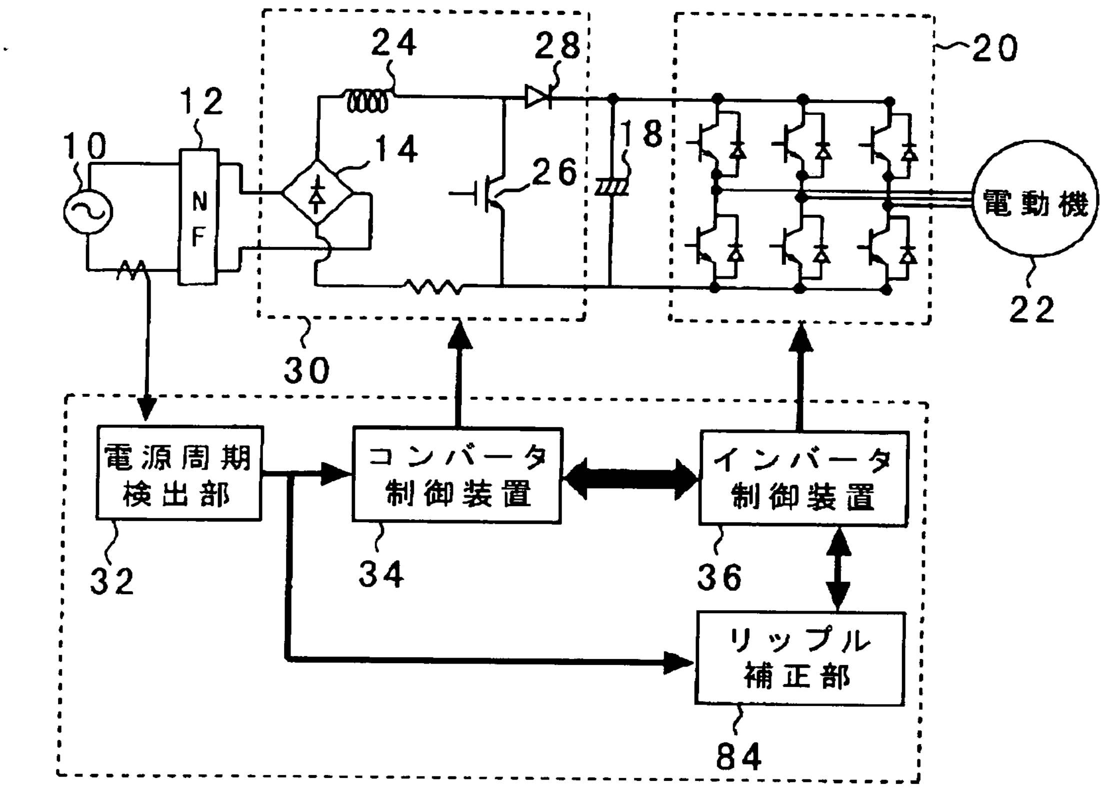

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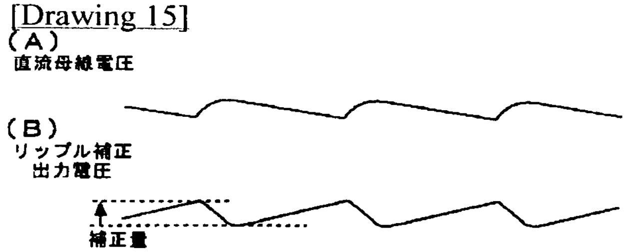

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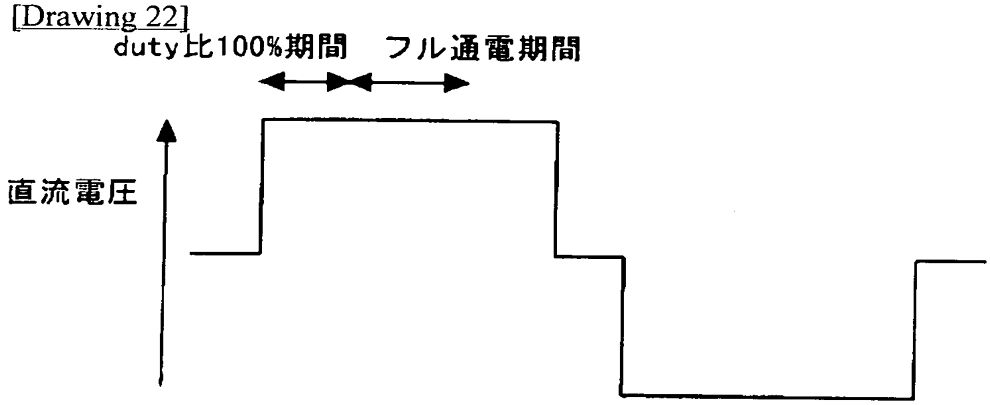

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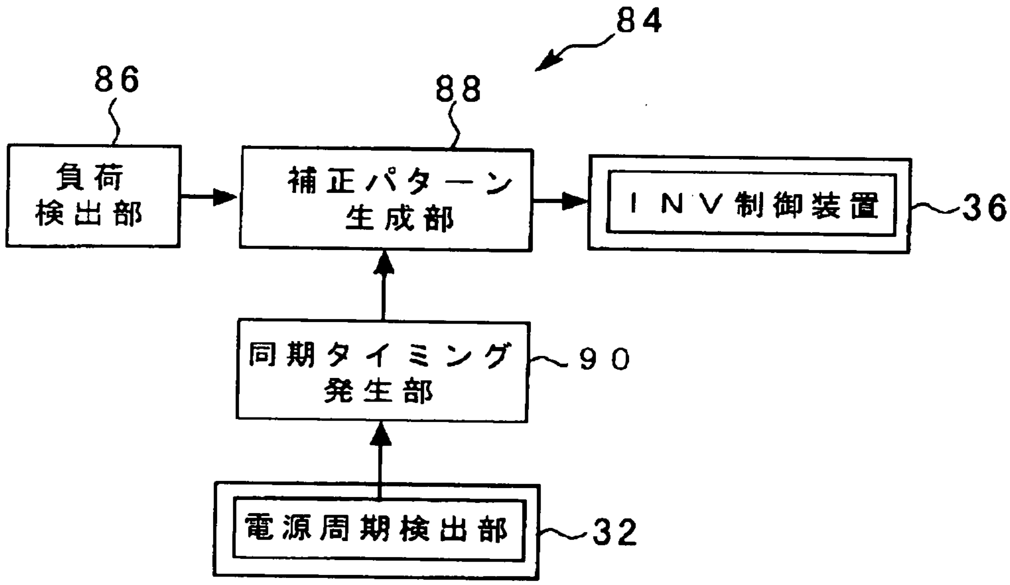

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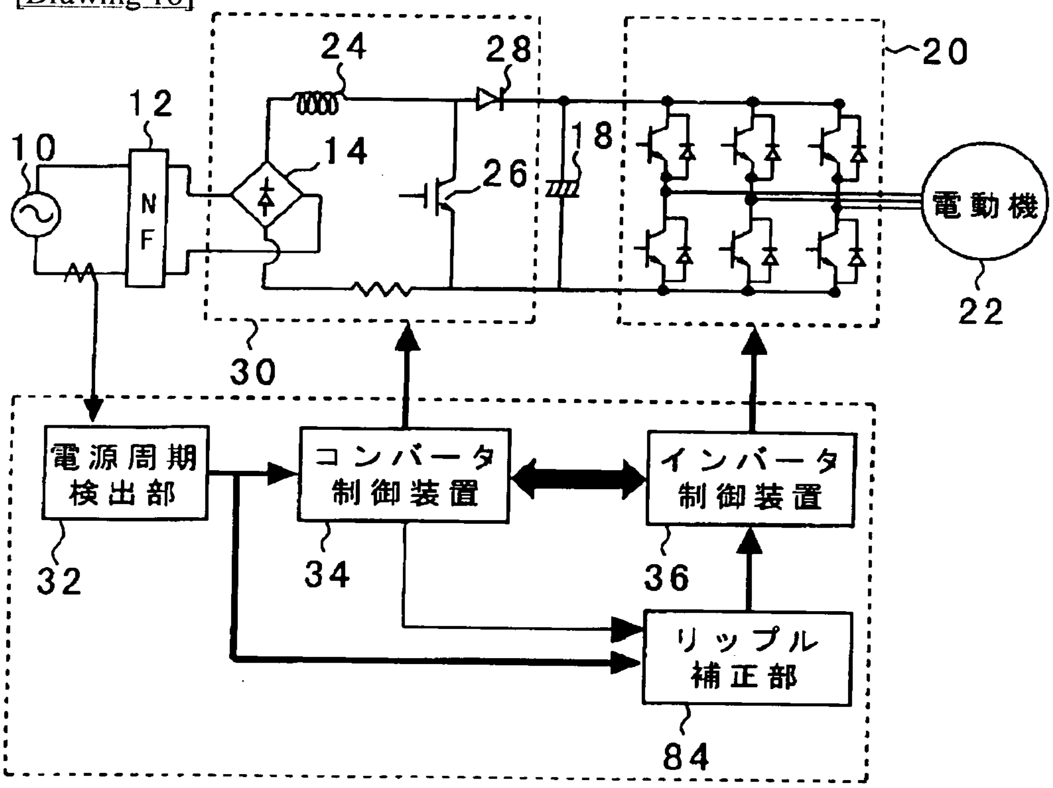

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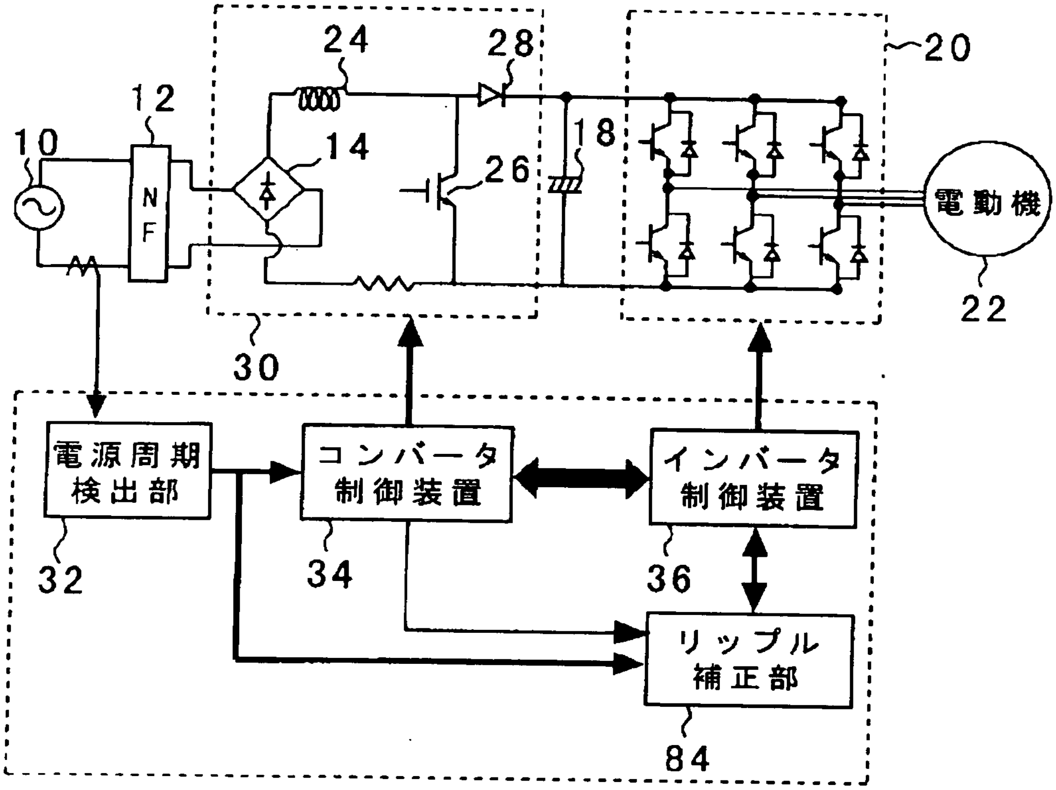

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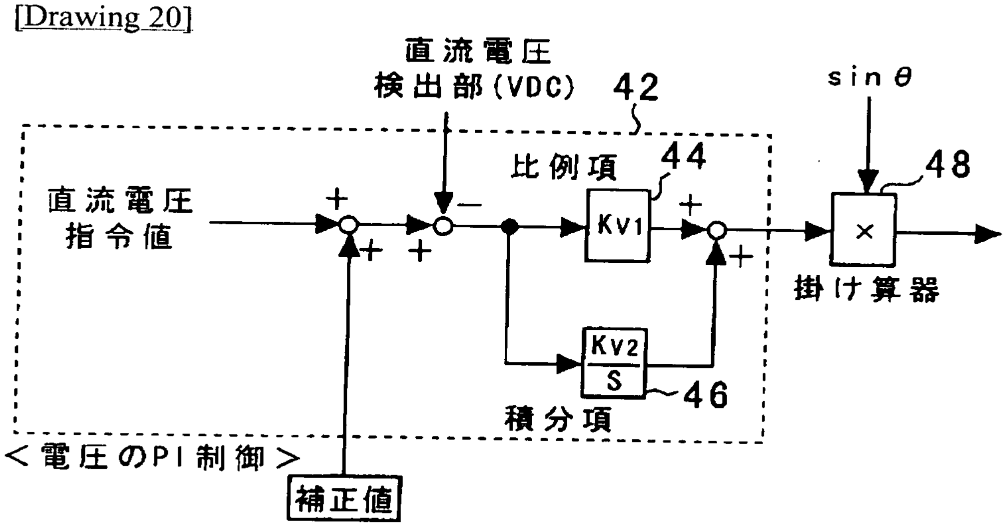

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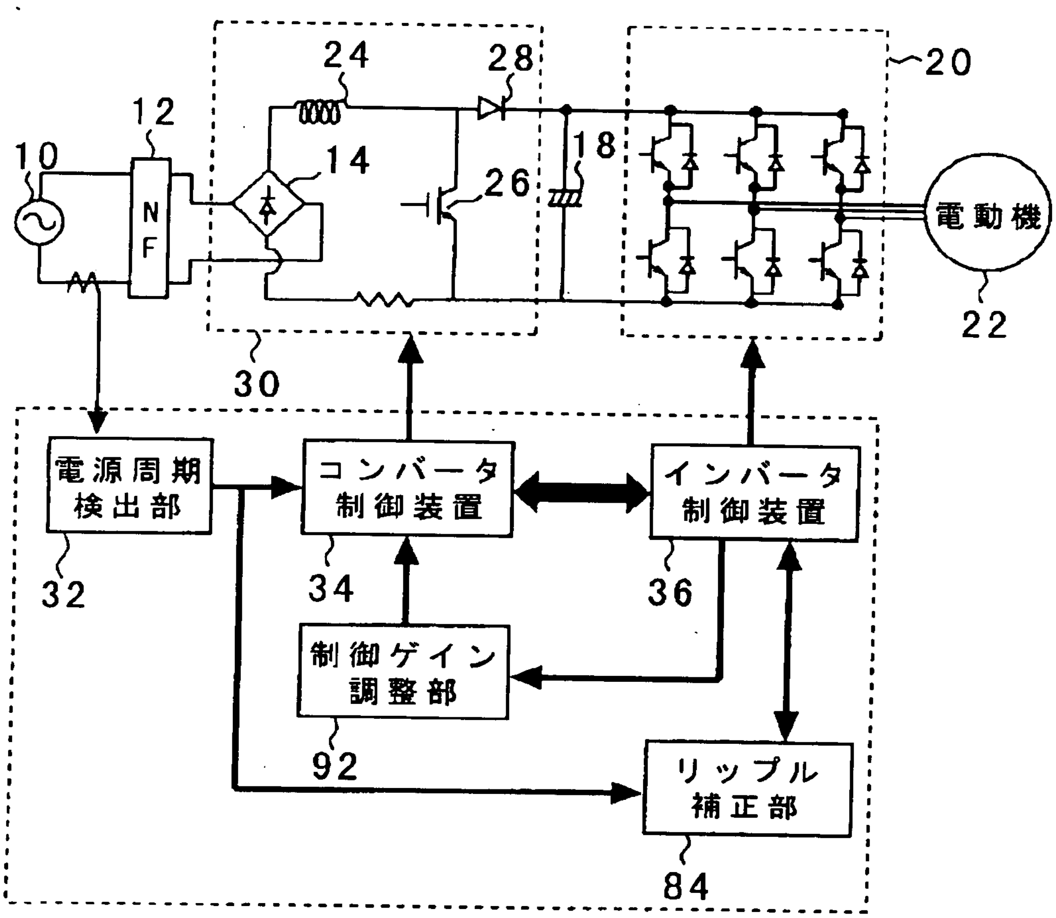

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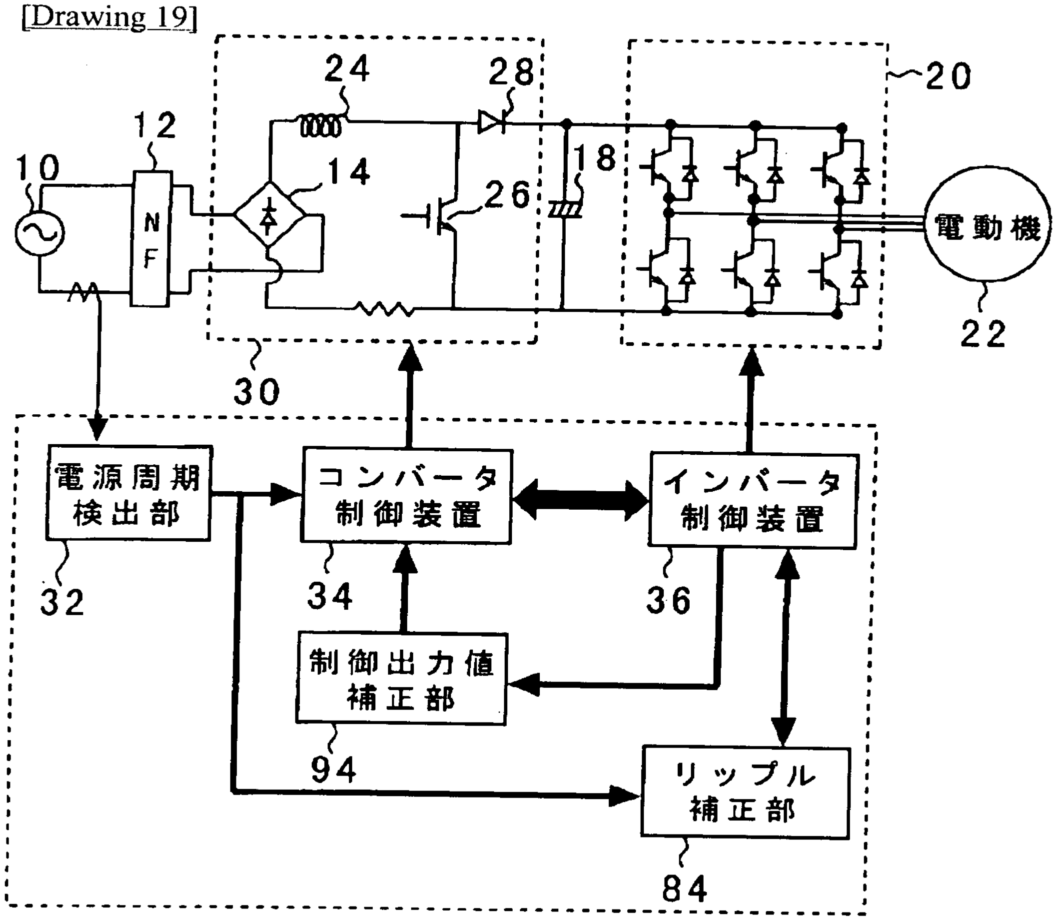

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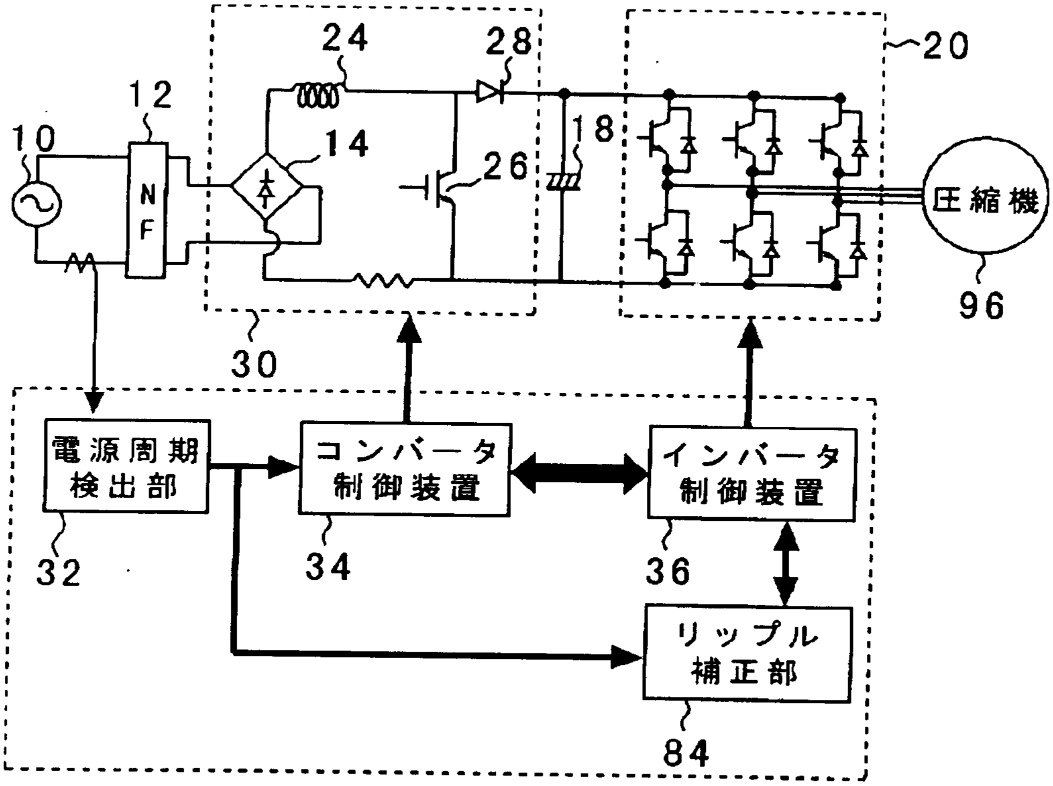

10
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30
圧縮機
96
電源周期
検出部
コンバータ
制御装置
インバータ
制御装置
リップル
補正部
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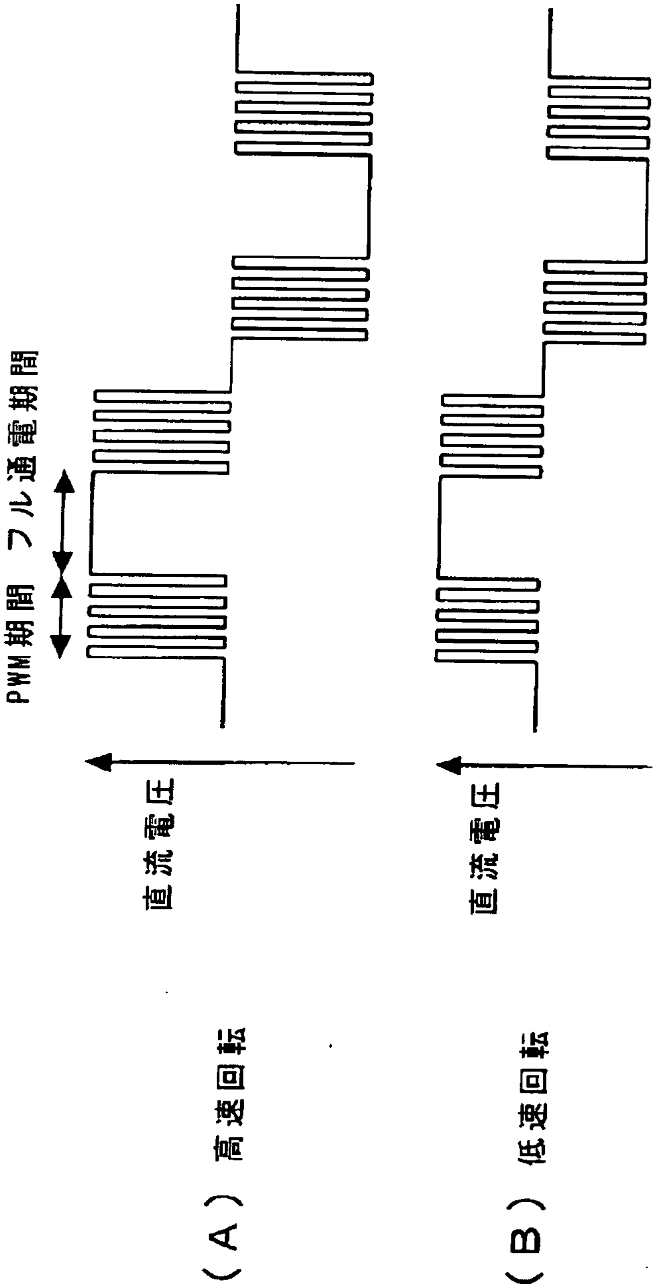
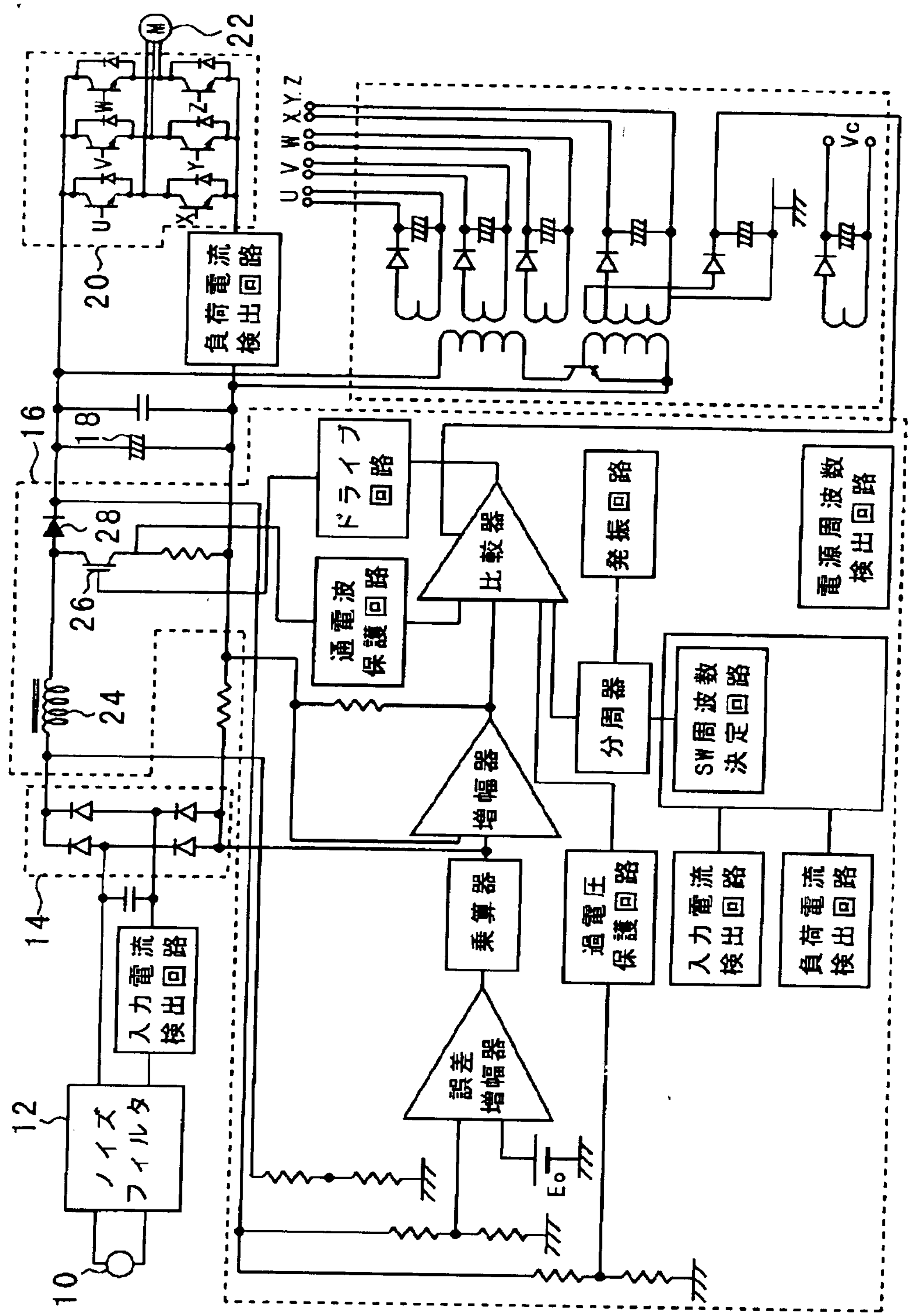
[Drawing 23]



[Drawing 24]



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